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II.—*Discussion of Tidal Observations made by direction of the Royal Irish Academy in* 1850–51. *By the* Rev. SAMUEL HAUGHTON, *M. A., Fellow of Trinity College, and Professor of Geology in the University of Dublin.*

Read April 24th, 1854.

PART FIRST.

THE SOLAR AND LUNAR DIURNAL TIDES ON THE COASTS OF IRELAND.

IN the autumn of 1850 tidal observations were commenced at twelve stations on the coasts of Ireland, under the direction of the Committee of Science of the Royal Irish Academy. One of these stations, Kilrush, county of Clare, was abandoned shortly after the commencement of the observations, in consequence of difficulties experienced in obtaining a sufficiently sheltered position for the tide-gauge; and at another station, Killybegs, county of Donegal, the observations made were not of so complete a character as at the remaining ten stations.

At the request of the Committee of Science, I undertook the task of reducing and discussing the tidal observations, the reduction of the meteorological observations being undertaken by the Rev. HUMPHREY LLOYD, whose Notes on the Meteorology of Ireland, deduced from those observations, have been recently published by the Academy.

The tidal observations made under the direction of the Academy were of two distinct kinds:—the first being the observation of all the High and Low Waters at each of ten stations, for periods varying from sixteen to twelve months; the second being the observation of complete tides, at intervals of fifteen minutes, the tides selected for this purpose being four in each lunation, two spring and two neap. These observations were made at eleven stations, and, like the former, extend over a period varying from sixteen to twelve months.

These two classes of observations were made for the purpose of throwing light upon different questions connected with the laws of the tides, the first class of observations being intended to furnish data for the separation of the effects of the Sun and Moon in the Diurnal Tide,—a problem not yet solved by observation ; the second class of observations being intended to illustrate the laws of the Semidiurnal Tide, particularly in the Irish Channel, and to decide the true mean height of the water round the coasts of Ireland.

As the two subjects are quite distinct, I have determined to present the results of my discussion of the tidal observations in separate communications to the Academy.

In the present communication I shall give the results of the calculations made from the daily observations, with a view to determine the separate effects of the Sun and Moon upon the Diurnal Tide.

SECTION I.—DESCRIPTION OF THE TIDAL STATIONS, AND OF THE TIDE-GAUGE USED IN THE OBSERVATIONS.

I. CASTLETOWNSEND, county of Cork. Lat. 51° 31′ N.; Long. 9° 7′ W.—The zero of the tide-gauge was carefully referred to the iron bolt driven vertically into the rock in which the Coast-guard signal-staff is secured.

The zero was 31·91 feet below this bolt. The gauge at this station was placed in the open sea, and was held in its place by stays and guys made fast to the rock.

II. CAHIRCIVEEN, county of Kerry. Lat. 51° 57′ N. ; Long. 10° 8′ W.—The zero of the tide-gauge, which was erected in the north-east angle above the bridge, was referred to a provisional bench-mark made on the corner coping-stone of the bridge.

The zero was 23·51 feet below this mark.

III. KILRUSH, county of Clare. Lat. 52° 38′ N. ; Long. 9° 26′ W.—The tide-gauge was placed at this station on the sea face of the steam-boat pier, and consequently exposed to the gales from the south-west. This was the only position in which it could be placed, and, unfortunately, it was twice washed away by the violence of the waves.

The zero was referred to the copper bolt driven vertically into one of the facing stones of the pier, and was found to be 20·59 feet below this bolt.

IV. Bunown, county of Galway. Lat. 53° 24′ N. ; Long. 10° 2′ W.—The tide-gauge at this station was erected at the inner side of the new pier built for the accommodation of fishing-boats, and was well sheltered from the west and south-west.

V. Killybegs, county of Donegal. Lat. 54° 38′ N. ; Long. 8° 24′ W.—Owing to the impossibility of erecting a tide-gauge at this station, in a position which would not be left dry at low water, it was determined to dispense with the daily observations, and to make the weekly observations with two tide-poles, one of which was fixed to the pier near the Coast-guard house, and the other on a rock at a short distance from the shore, the latter being used only when the base of the pier was dry at low water of spring tides. The correspondence of the figures on the two poles was carefully verified.

The zero of the tide-pole was 18·00 feet below the coping-stone of the pier to which it was fastened.

VI. Rathmullan, county of Donegal. Lat. 55° 7′ N. ; Long. 7° 32′ W.—The tide-gauge was erected in a sheltered situation, at the inner side of the pier.

Its zero was 20·20 feet below the upper surface of the corner coping-stone at the southern end of the pier.

VII. Portrush, county of Antrim. Lat. 55° 12′ N. ; Long. 6° 38′ W.—The tide-gauge was erected in an angle of the northern pier, close to the spot in which the tidal observations were made in 1842. It was referred to the copper bolt driven vertically into one of the facing-stones of the quay, and its zero was found to be 12·58 feet below this bolt.

VIII. Cushendall, county of Antrim. Lat. 55° 4′ N. ; Long. 6° 4′ W.—The tide-gauge at this station was erected on the landward side of the new pier in Red Bay.

The zero of the gauge was referred to the Ordnance bench-mark on the top of the wall, at the road side, north of the tunnel above the pier ; it was found to be 34·74 feet below this mark.

IX. Donaghadee, county of Down. Lat. 54° 38′ N. ; Long. 5° 33′ W.—The tide-gauge was erected beside the pier, close to the bolt driven vertically into one of the facing-stones of the quay, in a sheltered position, and with deep water at the lowest tides.

The zero of the gauge was 19·80 feet below this bolt.

X. KINGSTOWN, county of Dublin. Lat. 53° 17′ N.; Long. 6° 8′ W.—The gauge was placed in the inner angle of the new harbour, and was well sheltered from all points, particularly the north-east, from which direction large waves often enter Kingstown Harbour.

Its zero was referred to the copper bolt in the coping-stone of the pier near the water tank, and found to be 18·28 feet below this bolt.

XI. COURTOWN, county of Wexford. Lat. 52° 40′ N.; Long. 6° 12′ W.—Some difficulty was found at this station in selecting a suitable position for the tide-gauge, in consequence of the harbour having become partially filled with sand and gravel, forced into it by the sea. The gauge was placed beside the wooden landing stage, in the open sea, in rather an exposed position.

Its zero was found to be 17·13 feet below the copper bolt driven vertically into one of the facing-stones of the entrance to the harbour.

XII. DUNMORE (East), county of Waterford. Lat. 52° 8′ N.; Long. 6° 57′ W.—The tide-gauge was erected at the inner angle of the harbour, in a very sheltered position.

Its zero was referred to the copper bolt driven vertically into one of the facing-stones of the pier, not far from the light-house. It was found to be 17·59 feet below this bolt.

The twelve tidal stations just described were established between September, 1850, and January, 1851, and were each visited twice during the observations, by either Dr. LLOYD or myself. In these visits we were assisted by the following gentlemen, who rendered valuable assistance by their suggestions, and in levelling from the bench-marks to the zero of the gauges:—JAMES APJOHN, M. D., HENRY HEAD, M. D., Rev. JOSEPH A. GALBRAITH, JAMES R. BULWER, Esq., WALTER R. BULWER, Esq., and J. HANCOCK HAUGHTON, Esq. The time was found at each station by means of a vertical gnomon, with a meridian line, the observation of which at midday, with the aid of a table of the equation of time furnished to each observer, gave the local time with considerable accuracy.

The tide-gauge consisted of a wooden case, from twenty to twenty-eight feet in length, placed in a vertical position, and closed at the bottom, excepting a few holes, guarded by copper gauze. The bottom of the case was placed four or five feet below low-water mark, and the oscillations of the water outside were scarcely sensible within the case. To the top of the case was attached a box, containing a drum, over which was passed a silk cord, terminating at one extremity in a wooden float resting on the water, and at the other extremity in a small leaden counterpoise. The motion of the water inside the case was communicated by this cord to the drum, which was connected by wheel-work of a very simple character with the index-hand of a dial, marked into sixteen feet, each divided into tenths.

These dials, and the annexed wheel-work, were made by Mr. Dobbyn, of Wicklow-street, Dublin, and worked remarkably well during the whole time of being used. In addition to the index-hand traversing the dial, two other hands were placed on a separate axle, which were pushed in opposite directions by a projection placed on the index-hand, thus registering without observation the maximum and minimum heights of the tide. To obtain this registry it was only necessary to visit the dial twice during each lunar day, either at half-flood or half-ebb; and after a few day's practice, no difficulty was experienced by the observers in recording all the High and Low Waters, with a very slight expenditure of time.

The greatest care was taken to secure accurate determinations of the exact position of the zero marked outside the case, with reference to the Ordnance and other bench-marks, the zero of the dial being made to correspond with the zero outside. The gnomons by which the time was observed, were also erected with care, and I believe that with good observers the error in time would be less than one minute. To the observers themselves, who were all selected from the coast-guards at each station, too much praise can scarcely be given for the intelligence and patient industry with which they succeeded in carrying out the rules for observation, in which they were carefully instructed; and I believe it is not too much to assert, that so far as the observers were concerned, it would be impossible to have an extensive series of tidal observations made with greater care and accuracy.

Section II.—Method of Discussing the Daily Observations.

The daily observations consisted, as already mentioned, of observations of all the apparent High and Low Waters occurring each day. These observations of height were arranged in order of occurrence, and the Diurnal Tide in height, at High and Low Water, calculated from them in the following way.

The apparent height of the tide at any moment is made up of several quantities, of which the principal are:—

1. The Semi-diurnal Tide.
2. The Diurnal Tide.
3. Tides of long period, depending on the change of position of the Sun and Moon, or the Semi-menstrual and Semi-annual Tides.
4. Elevation or depression of the water, due to slow changes of barometric pressure.
5. Abrupt changes due to wind.

It is possible, by the following method, to separate in the observed High and Low Waters the part due to Diurnal Tide, and abrupt changes due to wind, from the first, third, and fourth quantities just mentioned.

Let h_1, h_2, h_3, h_4, h_5, be five successive High or Low Waters; the parts of these heights due to the first four causes can be represented by sines and cosines. Let $A \cos n\phi$ be the height due to any periodic cause, ϕ being an arc of fixed magnitude, and n a quantity increasing with the time in such a way that it is increased by unity in the interval between two High or Low Waters, i. e., in about $12^h\ 24^m$.

From this definition we have,

$$\begin{aligned} h_1 &= A \cos (n-2)\phi, \\ h_2 &= A \cos (n-1)\phi, \\ h_3 &= A \cos n\phi, \\ h_4 &= A \cos (n+1)\phi, \\ h_5 &= A \cos (n+2)\phi. \end{aligned}$$

Taking the fourth difference, we have, after some transformations,

$$\text{Fourth Difference} = h_1 - 4h_2 + 6h_3 - 4h_4 + h_5 = 16A \cos n\phi \sin^4 \tfrac{1}{2}\phi.$$

The right-hand member of this equation disappears for all the terms except the Diurnal Tide, and the abrupt changes of level caused by wind, which cannot be eliminated. In the Semi-diurnal Tide the value of ϕ is nearly 360°, and consequently $\sin^4 \frac{1}{2}\phi$ is evanescent. For the tides of long period, such as those under the third and fourth heads, it is a very small angle; for example, in the Semi-menstrual Tide ϕ is about 12° 37′; and, therefore,

$$\frac{\text{Fourth Difference}}{16A \cos n\,(12^\circ\,37')} = \sin^4 (6^\circ\,18') = 0{\cdot}000145,$$

a quantity which is perfectly insensible.

The slow changes of level due to the slow changes of atmospheric pressure will in like manner disappear from the Fourth Difference of the heights at High and Low Water, and there remains, therefore, nothing to consider but the Diurnal Tide, and the accidental changes due to sudden variations of wind. The latter cannot be eliminated by any process of calculation, as they simply produce the effect of making a particular height, or two or three successive heights, differ from their true values; they are to be considered as in the same category as errors of observation, and so far as they occur they vitiate the observations which they affect.

In the Diurnal Tide, on the contrary, the value of ϕ is nearly 180°, and, therefore, $\sin^4 \frac{1}{2}\phi$ is nearly unity; and consequently, the whole effect of the Diurnal Tide remains in the Fourth Difference of the successive heights, or,

$$\text{Diurnal Tide} = \frac{h_1 - 4h_2 + 6h_3 - 4h_4 + h_5}{16}. \qquad (1)$$

Having arranged the High and Low Waters for the ten stations in regular order, I employed two calculators, who were unconnected with each other, to calculate the Diurnal Tide for the High and Low Waters following the Moon's southing, from equation (1). These independent calculations were then compared, and wherever they differed I repeated the calculation myself, and in this manner secured the perfect accuracy of the figures which will be given in the Tables of this Memoir. Notwithstanding the accuracy of observation obtained by the form of tide-gauge used by us, and the evident care of the observers, there are occasional irregularities in these figures, which must be attributed to the fifth cause, mentioned in p. 40; and such irregularities happened principally during the stormy part of the year, and occasionally on the occurrence of isolated storms; but, on the whole, I believe the observations of the Diurnal Tide now presented to the Academy are the most perfect that have been ever made on so large a scale, and for such a length of time.

Having thus eliminated the Diurnal Tide from the observed heights, I constructed the Diurnal Tide at High and Low Water following the Moon's southing, by points, on paper ruled into divisions of tenths of an inch; on the scale of heights, of an inch to the foot; and of time, of five lunar days to the inch. After joining the points, a curve was drawn in the usual way, which represented geometrically the actual results of observation. These curves were then compared with other curves constructed from theory in the following way.

From whatever theory of tides we set out, whether the Equilibrium Theory, Laplace's Dynamical Theory, or Mr. Airy's Theory of Canal Waves, we arrive at the result that the Diurnal Tide is proportional to the product of the sine and cosine of the declination of the luminary; and the most general form of Diurnal Tide may be deduced from this supposition, combined with the well-known fact that the tide does not accompany, but follows, the southing of the luminary, and with the hypothesis of the Hydrodynamical Theories, that the position of the luminary, corresponding to any tide, is not its actual position, but the position it had at a period preceding the period of the tide, by an interval called the Age of the tide. We may, therefore, consider the following as the most general expression for the height of the Diurnal Tide; at least it is the expression deduced from theory, with which I have compared the observed Diurnal Tide:

$$D = S \sin \overline{2\sigma} \cos (s - i_s) + M \sin \overline{2\mu} \cos (m - i_m). \tag{2}$$

In this equation—

D is the height of the Diurnal Tide at the High or Low Water following the Moon's southing, expressed in feet.

S and M are the coefficients, in feet, of the Solar and Lunar Diurnal Tides.

$\bar{\sigma}$ and $\bar{\mu}$ are the declinations of the Sun and Moon, at a period preceding the High and Low Water, by an interval to be determined for each luminary, and called the Age of the Solar and Lunar Diurnal Tide.

s and m are the hour-angles of the Sun and Moon, west of the meridian, at the time of High or Low Water.

i_s and i_m are the Diurnal solitidal and lunitidal intervals, or the time which elapses between the Sun's or Moon's southing, and the Solar or Lunar Diurnal High Water.

The right-hand member of equation (2) therefore contains eight quantities, of which two only, m and s, are known directly by the observed time of apparent High and Low Water. The remaining six, three belonging to the Solar, and three to the Lunar Diurnal Tide, are to be determined; and being found, the values of D, calculated from (2), are to be compared with its values deduced from observation by means of equation (1).

The unknown quantities of the Diurnal Tide are, therefore,—

1st. The coefficients of Solar and Lunar Tide.

2nd. The Diurnal solitidal and lunitidal Intervals.

3rd. The Ages of the Solar and Lunar Tides.

Of these quantities, one, viz., the Age of the Solar Diurnal Tide, cannot be found from observation, because the Sun's place, or declination, changes so slowly that it is a matter of indifference what place we assign to the Sun (within a limit of some days) in estimating the amount of the Solar Tide. The other five quantities may and have been found from the observations, as I shall presently show.

The constants of equation (2) were found as follows for each of the ten Tidal Stations. An inspection of equation (2) shows that the Solar Diurnal Tide disappears at the equinoxes (because $\bar{\sigma} = 0$, or is very small); hence, the equinoctial Diurnal Tide, observed at High and Low Water, was altogether due to the Moon, and the Lunar Diurnal Tide was found approximately from the equinoctial tides, and constructed on the same abscissæ as the observed Diurnal Tide. This Lunar Tide constructed from calculation differs considerably from the observed Diurnal Tide at the solstices, the difference being due to the Solar Diurnal Tide; in this way the Solar Diurnal Tide was in its turn calculated approximately from the solstitial tides, and the calculated Solar Tide carefully superposed upon the Lunar Tide.

The observed and calculated tides, constructed as just described, were then compared both with reference to the maximum heights at High and Low Water, both positive and negative, and with reference to the times of vanishing of the Diurnal Tide at High and Low Water; and from this comparison the constants used in the construction were corrected, and the heights and times again compared, until the agreement was as close as the observations would allow.

The constants thus successively corrected are given at the end of the Table of Diurnal Tides, for each station, and the comparison of the observed and calculated tides is also given, so as to afford a very good idea of the degree of agreement between the observations and theory.

The constants of equation (2) are:—

Lunar Diurnal Tide.

1. Age of Tide.
2. Lunitidal Interval $= i_m$.
3. Coefficient of Lunar Tide $= M$.

Solar Diurnal Tide.

4. Age of Tide.
5. Solitidal Interval $= i_s$.
6. Coefficient of Solar Tide $= S$.

These constants were found as follows, from the comparison of the observed and calculated tides.

1. The Age of the Lunar Tide was found from the comparison of the times of vanishing of the observed and calculated tides.

2. The Lunitidal interval, $= i_m$, was found from the equation,

$$\cot (m - i_m) = \frac{\text{Range of Lunar Diurnal Tide at High Water}}{\text{Range of Lunar Diurnal Tide at Low Water}}. \qquad (3)$$

3. The Lunar coefficient, $= M$, was found from the equation,

$$2M \sin 2 \,(\text{max. value of } \mu) = \sqrt{\begin{array}{l}(\text{Range of Lunar Diurnal Tide at High Water})^2 \\ + (\text{Range of Lunar Diurnal Tide at Low Water})^2\end{array}}. \qquad (4)$$

4. The Age of the Solar Tide was not determined.

5. The Solitidal interval, $= i_s$, was found from the comparison of the solstitial intersections of the observed Diurnal Tide with the calculated Lunar Tide.

6. The Coefficient of the Solar Tide, $= S$, was found from the equation,—

$$2S \sin 2 \,(\text{max. value of } \sigma) = \text{Maximum Range of Solar Diurnal Tide}. \qquad (5)$$

I shall now proceed to the description of the Diurnal Tide at each Station, and the results obtained from the comparison of the observed and calculated tides, reserving for the conclusion of this Memoir some general reflections suggested by the facts observed at the different Stations.

SECTION III.—DIURNAL TIDE AT CASTLETOWNSEND.

Date.	Diurnal Tide at High Water.		Diurnal Tide at Low Water.	
1851.				
Jan. 13			6.45 A. M.	
14				−·106
15		+·218		−·131
16		−·437		+·081
17		−·025		+·081
18		+·006		+·043
19		−·125		+·018
20	6 A. M.	−·018	12.15 P. M.	−·062
21		−·037		−·112
22		−·081		+·037
23		−·025		+·018
24		−·112		−·087
25		+·131		−·131
26		+·193		−·131
27	1.15 P. M.	+·181	7.30 P. M.	+·062
28		+·168		−·037
29		+·075		+·087
30		−·031		+·150
31		−·075		+·193
Feb. 1		−·118		+·125
2		−·100		+·012
3	6.30 P. M.	+·012		−·093
4		·000		−·043
5		+·243		−·181
6		+·187		+·006
7		+·100		−·012
8		+·068		+·068
9, 10		−·056		+·025
11		−·050	6.15 A. M.	−·043
12		+·006		+·062
13		−·043		+·068
14		−·018		−·093
15		−·012		−·056
16		−·037		−·006
17		·000		−·025
18	6.15 A. M.	−·043	12.30 P. M.	−·037
19		−·006		·000
20		−·031		−·068
21		+·018		−·181
22		+·025		−·081
23		−·118		−·006
24		−·012		·000
25	1 P. M.	−·112	7.30 P. M.	−·150
26		−·031		−·012
27		−·062		+·031
1851.				
Feb. 28		−·025		−·025
Mar. 1		−·037		−·062
2		+·050		−·068
3		+·012		−·012
4		−·062		−·037
5	6.45 P. M.	−·025		−·143
6		+·062		−·062
7		+·056		+·025
8		+·100		+·131
9		+·087		+·031
10, 11		−·087		−·093
12		−·012	5.30 A. M.	−·037
13		−·081		−·075
14		−·050		−·075
15		+·075		−·025
16		+·043		+·012
17		+·125		−·018
18		+·143		+·012
19	5.30 A. M.	+·012	Noon.	+·081
20		−·018		+·018
21		−·081		−·037
22		+·050		+·231
23		−·037		+·087
24		−·062		+·050
25		−·081		−·025
26	Noon.	−·093	6.30 P. M.	+·043
27		−·137		+·006
28		−·093		−·006
29		−·056		−·056
30		+·081		−·031
31		+·012		−·100
April 1		−·012		−·231
2		−·087		+·131
3	6.45 P. M.	+·206		+·256
4		−·012		−·100
5		+·031		−·087
6		−·012		+·018
7		+·006		−·131
8		+·037		−·043
9, 10		+·068		+·037
11		+·018	6.15 A. M.	+·050
12		−·062		+·025
13		−·043		+·025
14		+·012		+·025
15		+·056		·000

DIURNAL TIDE AT CASTLETOWNSEND—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
April 16	−·018	−·006	June 1	·000	·000
17	−·125	+·050	2	6.30 P. M. +·031	−·043
18	6 A. M. −·037	12.15 P. M. +·087	3	·000	−·068
19	+·087	+·081	4	−·293	−·037
20	−·043	+·087	5	−·056	+·068
21	−·131	+·031	6	−·043	+·031
22	−·075	+·062	7	−·218	+·056
23	+·056	+·031	8	−·156	6.45 A. M. +·175
24	−·081	−·106	9	+·050	+·025
25	12.30 P. M. −·168	7 P. M. −·075	10, 11	+·012	+·062
26	−·025	−·112	12	+·006	+·018
27	−·056	−·075	13	+·012	+·025
28	·000	+·006	14	−·006	−·131
29	+·050	−·025	15	−·037	·000
30	+·062	−·068	16	−·106	+·056
May 1	+·012	−·144	17	6.30 A. M. −·112	12.15 P. M. +·106
2	+·006	·000	18	−·094	+·012
3	6 P. M. −·012	+·031	19	−·068	+·081
4	−·225	−·062	20	−·062	+·012
5	−·137	−·037	21	+·056	+·006
6	+·025	+·018	22	+·031	+·037
7	+·031	+·081	23	11.30 A. M. −·062	6.15 P. M. +·143
8, 9	+·018	+·037	24	−·018	+·056
10	+·037	6 A. M. +·012	25	+·012	+·068
11	−·012	−·031	26	+·050	+·012
12	−·100	+·081	27	+·137	−·006
13	·000	+·031	28	+·025	−·037
14	+·043	−·012	29	+·018	+·006
15	−·093	−·006	30	+·012	+·018
16	−·037	+·031	July 1	5.30 P. M. +·131	−·093
17	6 A. M. −·050	Noon. +·118	2	+·037	−·006
18	−·106	+·081	3	+·050	+·031
19	−·037	+·106	4	+·043	+·081
20	−·043	−·012	5	·000	+·025
21	−·075	−·112	6	−·031	+·012
22	−·087	−·018	7	−·006	−·037
23	−·043	+·006	8	−·012	−·056
24	Noon. −·081	6 P. M. −·106	9	+·056	6.45 A. M. −·093
25	−·081	−·037	10	−·050	+·075
26	−·018	+·018	11	+·025	+·018
27	−·006	+·050	12	−·012	−·050
28	−·018	−·006	13, 14	−·050	−·056
29	−·019	·000	15	5.45 A. M. −·281	Noon. +·062
30	−·056	−·012	16	−·125	+·050
31	−·012	−·006	17	−·087	+·056

Diurnal Tide at Castletownsend—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
July 18	−·031	+·306	Sept. 2	+·006	−·018
19	+·056	−·175	3	·000	+·056
20	−·031	+·006	4	−·087	5.15 A. M. +·025
21	+·050	+·044	5	−·100	−·025
22	+·087	−·019	6	−·081	+·156
23	11.20 A. M. +·081	5 P. M. +·006	7	−·056	+·037
24	+·112	−·043	8	·000	·000
25	+·056	−·031	9	−·006	−·025
26	−·012	−·037	10, 11	−·012	−·106
27	+·100	−·050	12	5.15 A. M. −·012	11.30 A. M. +·050
28	+·162	−·031	13	−·018	+·050
29	+·187	+·100	14	−·081	·000
30	6.15 P. M. +·087	−·018	15	−·018	−·031
31	+·081	−·006	16	·000	·000
Aug. 1	+·050	−·031	17	−·112	+·050
2	+·068	+·012	18	−·050	+·006
3	+·037	+·050	19	−·031	+·050
4	−·006	+·037	20	11.45 A. M. −·100	6 P. M. −·043
5	+·012	+·125	21	−·081	+·206
6	−·062	5.45 A. M. +·025	22	+·037	+·125
7	−·093	+·018	23	+·106	−·143
8	−·112	−·025	24	+·100	−·087
9	−·006	−·012	25	−·031	−·043
10	+·087	−·043	26	−·012	+·012
11, 12	−·056	−·031	27	6.15 P. M. +·025	+·062
13	5.15 A. M. −·037	11.15 A. M. +·062	28	−·175	+·068
14	+·075	+·081	29	+·112	−·200
15	+·087	+·062	30	+·075	−·281
16	+·062	−·025	Oct. 1	+·043	−·031
17	+·012	+·012	2	−·093	−·031
18	+·093	+·018	3	−·156	+·181
19	+·056	+·062	4	−·168	6.15 A. M. +·231
20	+·018	+·093	5	−·025	+·081
21	11 A. M. ·000	5.22 P. M. +·068	6	−·068	−·012
22	−·012	+·025	7	−·081	−·025
23	−·031	−·075	8, 9	−·037	+·043
24	−·031	−·050	10	4.30 A. M. −·087	10.45 A. M. −·006
25	−·068	+·062	11	+·031	+·018
26	+·118	+·043	12	·000	+·025
27	+·200	−·031	13	+·068	−·043
28	5.30 P. M. +·043	+·037	14	−·125	−·050
29	−·037	+·056	15	−·062	+·012
30	+·006	+·068	16	−·037	+·062
31	−·156	+·125	17	−·050	+·025
Sept. 1	−·112	−·075	18	+·043	+·043

DIURNAL TIDE AT CASTLETOWNSEND—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
Oct. 19	+·093	+·031	Nov. 25	6 P. M. −·050	−.062
20	12.45 P. M. −·043	7 P. M. −·093	26	−·087	−·012
21	−·043	−·300	27	−·062	−·018
22	−·100	−·143	28	−·100	−·012
23	−·181	−·012	29	−·043	+·212
24	·000	−·018	30	·000	+·087
25	+·093	−·012	Dec. 1	−·093	+·043
26	−·018	−·068	2	−·050	6.15 A. M. +·087
27	6.30 P. M. −·118	+·031	3	−·018	+·062
28	−·093	+·106	4	+·018	+·081
29	−·050	−·006	5	+.037	+·118
30	−·050	−·025	6	−·312	−·043
31	−·050	−·081	7	+·006	−·187
Nov. 1	−·068	+·006	8, 9	−·050	+·143
2	−·068	−·012	10	6 A. M. −·106	Noon. −·250
3	·000	7 A. M. +·143	11	−·118	+·056
4	−·050	+·137	12	+·075	+·068
5	−·037	−·025	13	+·006	+·025
6	·000	+·043	14	+·050	−·025
7	−·025	+·062	15	+·025	−·012
8, 9	+·012	+·018	16	+·075	+·031
10	5.30 A. M. +·012	11.45 A. M. +·075	17	Noon. +·087	6.15 P. M. −·031
11	−·106	+·012	18	+·137	−·056
12	+·137	−·050	19	−·006	−·137
13	+·043	−·056	20	−·018	−·031
14	·000	+·087	21	−·118	+·093
15	−·031	+·100	22	−·006	+·012
16	+·062	·000	23	−·106	+·118
17	+ 125	−·056	24	6.15 P. M. −·012	+·018
18	12.15 P. M. +·087	6.30 P. M. −·087	25	·000	−·037
19	·000	−·168	26	+·287	+·012
20	+·037	−·062	27	+·006	+·081
21	−·043	−·018	28	+·075	+·056
22	−·025	·000	29	+·043	+·075
23	−·068	−·006	30		
24	−·043	−·087	31		

Having constructed the observations contained in the preceding Tables by means of curves, as described in p. 42, I found it impossible to separate the effects of the Sun and Moon. The tide is so small, and its times of vanishing consequently so badly marked, that it was not possible to divide it with any kind of certainty into a Solar and Lunar Tide. I, therefore, supposed the tide to be due to the Moon only, and made the following inferences, which I do not however, consider as of high value.

The mean of all the maximum values of the tide at High Water was found to be $+0{\cdot}0885$ and $-0{\cdot}0835$, giving an average range at High Water of 0·1720.

The mean of all the maximum values at Low Water was found to be $+0{\cdot}0820$ and $-0{\cdot}0906$, giving an average range at Low Water of 0·1726.

If, therefore, h and l represent the ranges of Diurnal Tide at High and Low Water respectively, we have by equation (2)

$$h = 2M \sin (2 \text{ Max. Declination}) \times \cos (m - i_m),$$
$$l = 2M \sin (2 \text{ Max. Declination}) \times \cos (90^\circ + m - i_m),$$

and consequently, by equation (3),

$$\frac{h}{l} = -\cot (m - i_m).$$

Substituting for h and l their values we find,

$$\frac{0{\cdot}1720}{0{\cdot}1726} = \cot (m - i_m) = \cot (45^\circ\ 6'),$$

and converting 45° 6′ into time, we have

$$m - i_m = 3^h\ 6^m;$$

but m, at the time of High Water, is the Establishment at Castletownsend expressed in local time, and is equal to $4^h\ 17^m$; therefore $i_m = 1^h\ 11^m$.

Equation (4) also gives us the relation

$$2M \sin (2 \text{ Max. Declination}) = \sqrt{h^2 + l^2}.$$

Hence,

$$2M = \frac{\sqrt{h^2+l^2}}{\sin 42^\circ} = \frac{0{\cdot}234}{0{\cdot}669} = 0{\cdot}363 \text{ ft.}$$

If, therefore, the Diurnal Tide at Castletownsend be supposed wholly due to the Moon, it may be expressed by the formula

$$D = 0{\cdot}181 \sin \overline{2\mu} \cos (m - 1^h\ 11^m). \qquad (6)$$

In this equation, μ, the Moon's declination, is to be assumed for a period preceding the time of observation; but the length of this period or Age of the Tide could not be ascertained in consequence of the irregularity of the times of vanishing.

It appears from the preceding investigation, that the maximum effect in raising or lowering the sea, produced by the Diurnal Tide at Castletownsend, is,

$$0{\cdot}181 \text{ ft.} \times \sin 42^\circ = 0{\cdot}117 \text{ ft.} = 1{\cdot}4 \text{ inches},$$

the total effect both ways being less than three inches; consequently the water will be raised 1·4 in. when the Moon has crossed the meridian $1^h\ 11^m$, and depressed by the same amount when the Moon has crossed the lower meridian $1^h\ 11^m$.

It is not surprising that it should be difficult to separate such a small effect as this into a Solar and Lunar Tide.

Section IV.—Diurnal Tide at Cahercibeen.

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1850.			1850.		
Oct. 1		5.45 A.M.	November		
2	+·100	−·328	1	−·038	−·214
3	+·228	−·294	2	−·039	−·114
4	+·125	−·387	3	−·066	−·042
5	+·040	−·500	4	−·205	−·053
6	+·369	−·372	5	−·120	+·043
7	+·245	−·026	6	−·213	+·083
8	5.45 P.M. +·023	−·024	7	5.45 P.M. −·176	−·160
9	−·092	−·017	8, 9	−·240	+·303
10	−·112	+·078	10	−·218	+·353
11	−·131	+·178	11	−·237	+·378
12	−·215	+·153	12	−·258	+·388
13	−·255	+·144	13	−·181	+·321
14, 15	−·186	+·215	14	−·110	6.15 A.M. +·340
16	−·060	7.15 A.M. +·315	15	−·058	+·320
17	−·080	+·263	16	+·023	+·310
18	−·099	+·210	17	−·036	+·209
19	+·054	+·024	18	+·050	+·029
20	−·037	+·024	19	·479	+·024
21	−·097	+·156	20	+·238	+·073
22	−·090	+·019	21	+·133	+·141
23	−·056	−·399	22	5.30 A.M. +·002	11.45 A.M. −·144
24	5.30 A.M. +·009	Noon. −·555	23	+·071	−·369
25	+·022	−·136	24	+·310	−·155
26	+·100	−·156	25	−·012	−·376
27	+·131	−·244	26	+·054	−·400
28	+·173	−·344	27	+·026	−·439
29	+·076	−·247	28	−·067	−·464
30	−·030	−·369	29	1 P.M. +·015	7 P.M. −·380
31	1.30 P.M. −·075	7.45 P.M. −·400	30	−·003	−·046

DIURNAL TIDE AT CAHERCIVEEN—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1850.			1851.		
Dec. 1	−·051	−·028	Jan. 14	+·031	+·256
2	−·212	−·068	15	+·306	+·487
3	−·075	+·068	16	−·350	+·637
4	−·175	+·281	17	−·381	−·018
5	−·275	+·312	18	+·037	−·393
6	5.45 P. M. −·300	+·412	19	+·275	−·343
7	−·381	+·412	20	5.45 A. M. +·231	Noon. +·243
8	−·356	+·368	21	+·300	−·293
9	−·356	+·356	22	+·175	+·206
10	−·125	+·387	23	−·100	+·850
11	−·131	+·318	24	+·268	+·268
12, 13	−·006	+·537	25	+·231	−·206
14	−·243	6.15 A. M. +·543	26	−·031	+·156
15	−·293	+·281	27	1.15 P. M. +·012	7.15 P. M. +·568
16	−·350	+·343	28	−·187	+·131
17	−·100	+·250	29	−·231	−·018
18	−·025	+·181	30	−·231	+·043
19	+·062	−·125	31	−·275	+·093
20	+·118	−·200	Feb. 1	−·280	+·106
21	5.30 A. M. +·312	11.30 A. M. −·287	2	−·137	+·393
22	+·206	−·393	3	5.45 P. M. −·218	+·293
23	+·256	−·418	4	−·187	+·312
24	+·143	−·381	5	−·100	+·231
25	+·043	−·581	6	−·212	+·406
26	+·012	−·431	7	−·156	+·187
27	−·012	−·418	8	−·162	+·300
28	12.30 P. M. −·100	6.45 P. M. −·250	9, 10	−·175	−·187
29	−·181	−·231	11	+·043	4.30 A. M. −·056
30	−·243	−·218	12	+·062	−·093
31	−·275	−·018	13	+·087	−·068
			14	+·050	−·131
1851.			15	+·081	−·287
Jan. 1	+·143	+·300	16	−·143	−·462
2	−·100	+·250	17	+·175	−·437
3	−·318	+·281	18	6 A. M. +·387	Noon. −·412
4	6.15 P. M. −·400	−·100	19	+·343	−·306
5	−·231	+·087	20	+·193	−·231
6	−·331	+·431	21	+·175	−·187
7	−·400	+·381	22	+·087	−·112
8	−·325	+·062	23	−·018	−·112
9	−·100	+·356	24	−·150	−·012
10	−·118	+·437	25	12.30 P. M. −·150	7.15 P. M. +·075
11, 12	+·118	+·262	26	−·150	+·181
13	+·100	6.15 A. M. +·325	27	−·206	+·206

DIURNAL TIDE AT CAHERCIVEEN—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
Feb. 28	−·100	+·225	April 16	−·025	−·256
Mar. 1	−·168	+·243	17	+·037	−·118
2	−·162	+·300	18	5.45 A. M. +·037	11.45 A. M. −·013
3	−·312	+·200	19	+·093	+·175
4	−·225	+·212	20	−·131	+·275
5	6 P. M. −·225	+·137	21	−·125	+·331
6	−·256	+·075	22	−·118	+·337
7	−·112	+·050	23	−·143	+·393
8	−·106	+·212	24	−·106	+·431
9	−·106	+·125	25	1 P. M. −·056	7 P. M. +·325
10, 11	−·193	−·100	26	−·062	+·100
12	−·050	5.15 A. M. −·187	27	−·100	+·168
13	−·143	−·293	28	−·100	+·200
14	+·006	−·287	29	−·050	+·131
15	+·056	−·387	30	−·043	+·050
16	+·093	−·425	May 1	−·037	+·037
17	+·325	−·175	2	+·025	+·006
18	+·456	−·106	3	5.30 P. M. +·143	−·056
19	5.15 A. M. +·037	11.15 A. M. −·025	4	+·125	−·118
20	−·037	−·075	5	+·168	−·206
21	+·156	−·006	6	+·087	−·337
22	+·093	+·143	7	+·087	−·300
23	+·006	+·100	8, 9	−·018	−·468
24	−·112	+·031	10	−·031	5.45 A. M. −·512
25	−·043	+·093	11	−·087	−·450
26	12.15 P. M. −·043	6.45 P M. +·181	12	−·143	−·268
27	−·056	+·268	13	−·050	−·187
28	−·093	+·275	14	−·056	−·212
29	−·231	+·218	15	−·118	−·168
30	−·268	+·200	16	−·137	−·025
31	−·168	+·143	17	5.80 A. M. −·075	11.15 A. M. +·100
April 1	−·056	+·112	18	−·075	+·175
2	−·050	+·150	19	−·268	+·262
3	5.30 A. M. −·100	+·125	20	−·250	+·325
4	−·125	+·093	21	−·012	+·350
5	−·050	−·037	22	−·162	+·456
6	+·025	−·081	23	−·193	+·406
7	+·037	−·081	24	11.45 A. M. −·106	6.15 P. M. +·318
8	+·062	−·181	25	−·043	+·287
9, 10	+·081	−·300	26	+·025	+·218
11	+·012	6.30 A. M. −·362	27	+·068	+·150
12	−·056	−·268	28	+·037	+·068
13	−·093	−·331	29	+·087	+·056
14	−·037	−·400	30	+·131	+·037
15	−·025	−·287	31	+·193	−·025

DIURNAL TIDE AT CAHERCIVEEN—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
June 1	+·131	-·137	July 18	-·256	+·306
2	6.30 P. M. +·081	-·212	19	-·162	+·406
3	+·087	-·406	20	-·225	+·356
4	+·200	-·475	21	-·137	+·325
5	+·175	-·462	22	-·018	+·268
6	+·037	-·556	23	Noon. +·062	6.15 P. M. +·187
7, 8	-·056	-·475	24	+·037	+·043
9	-·143	6.30 A. M. -·306	25	+·125	-·025
10	-·150	-·168	26	+·168	-·150
11	-·306	-·306	27	+·225	-·206
12	-·181	-·112	28	+·143	-·281
13	-·237	+·006	29	+·162	-·393
14	-·212	+·175	30	5.30 P. M. +·168	-·412
15	-·281	+·250	31	+·212	-·493
16	5.45 A. M. -·343	11.45 A. M. +·293	Aug. 1	+·256	-·437
17	-·356	+·331	2	+·200	-·368
18	- 293	+·343	3	+·162	-·312
19	-·281	+·412	4, 5	+·068	-·200
20	-·231	+·368	6	-·106	5 A. M. -·175
21	-·200	+·406	7	-·200	-·081
22	-·206	+·306	8	-·243	+·093
23	12.15 P. M. -·050	6.15 P. M. +·268	9	-·306	+·200
24	+·006	+·212	10	-·306	+·225
25	-·012	+·112	11	-·275	+·187
26	+·068	+·006	12	-·350	+·325
27	+·143	-·431	13	5 A. M. -·400	11 A. M. +·318
28	+·187	-·500	14	-·306	+·281
29	+·206	-·181	15	-·300	+·287
30	+·206	-·231	16	-·237	+·318
July 1	5.45 P. M. +·212	-·281	17	-·212	+·256
2	+·218	-·481	18	-·162	+·231
3	+·237	-·712	19	-·056	+·250
4	+·187	-·562	20	-·006	+·118
5	+·150	-·500	21	11.15 A. M. +·075	5.30 P. M. -·037
6, 7	+·068	-·425	22	+·143	-·125
8	-·018	6.15 A. M. -·262	23	+·112	+·256
9	-·175	-·150	24	+·075	+·368
10	-·143	-·056	25	+·012	-·337
11	-·231	+·131	26	+·093	-·400
12	-·325	+·231	27	+·256	-·306
13	-·368	+·268	28	5.15 P. M. +·175	-·306
14	-·393	+·200	29	+·150	-·356
15	5.30 A. M. -·318	11.30 A. M. +·318	30	+·143	-·337
16	-·356	+·350	31	+·118	-·206
17	-·331	+·393	Sept. 1, 2	+·025	-·087

DIURNAL TIDE AT CAHERCIVEEN—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
Sept. 3	−·093	±·000	Oct. 19	+·125	−·493
4	−·162	5.15 A. M. +·075	20	12.45 P. M. +·087	7 P. M. −·437
5	−·175	+·206	21	+·012	−·337
6	−·206	+·250	22	+·056	−·212
7	−·262	+·293	23	+·100	−·425
8	−·225	+·287	24	−·018	−·287
9	−·250	+·256	25	−·043	−·231
10	−·262	−·037	26	−·012	−·087
11	−·256	−·012	27	6 P. M. −·137	+·006
12	5 A. M. −·231	10.45 A. M. +·281	28	−·050	+·237
13	−·268	+·156	29	−·093	+·293
14	−·243	+·150	30	−·187	+·356
15	−·193	+·137	31	−·137	+·150
16	−·075	+·118	Nov. 1, 2	−·025	+.306
17	−·031	+·137	3	+·012	6.15 A. M. +·312
18	±·000	+·050	4	+·025	+·325
19	+·068	−·068	5	−·068	+·293
20	11.45 A. M. +·093	6.15 P. M. −·237	6	−·062	+·256
21	+·100	−·306	7	−·025	+·175
22	+·043	−·306	8	−·012	+·081
23	+·043	−·337	9	−·043	+·093
24	+·162	−·231	10	5 A. M. −·025	11 A. M. +·043
25	+·093	−·212	11	−·031	−·125
26	+·075	−·187	12	+·118	−·137
27	5.30 P. M. +·087	−·206	13	+·093	−·143
28	−·143	−·243	14	+·175	−·262
29	−·081	−·212	15	+·200	−·375
30	+·043	+·181	16	+·125	−·381
Oct. 1	−·275	+·418	17	+·043	−·412
2, 3	−·387	+·268	18	12.30 P. M. −·087	6.30 P. M. −·500
4	−·168	6 A. M. +·068	19	−·131	−·493
5	−·112	+·037	20	−·206	−·387
6	−·268	+·175	21	−·106	−·368
7	+·031	+·312	22	−·043	−·200
8	−·143	+·237	23	−·125	−·037
9	−·081	+·293	24	−·187	+·137
10	−·131	+·187	25	5.30 P. M. −·168	+·168
11	4.45 A. M. −·131	10.30 A. M. +·325	26	−·262	+·293
12	−·150	+·131	27	−·268	+·325
13	+·056	+·100	28	−·256	+·393
14	+·081	−·012	29, 30	−·250	+·400
15	−·106	−·156	Dec. 1	−·168	+·368
16	+·043	−·231	2	−·087	5.30 A. M. +·337
17	+·087	−·156	3	−·062	+·312
18	+·081	−·281	4	±·000	+·293

Diurnal Tide at Cahirciveen—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
Dec. 5	+·043	+·193	Dec. 19	−·093	−·250
6	+·093	+·162	20	−·037	−·068
7	+·056	−·112	21	−·056	−·081
8	−·118	−·381	22	−·287	−·050
9	−·187	−·268	23	+·043	+ 206
10	5 A. M. +·300	11.15 A. M. −·187	24	5.30 P. M. −·118	+·356
11	+·275	−·250	25	−·287	+·456
12	+·287	−·281	26	−·287	+·468
13	+·187	−·368	27	−·356	+·375
14	+·106	−·481	28	−·293	+·306
15	+·037	−·568	29	−·250	+·375
16	+·012	−·531	30	−·175	
17	11.30 A. M. −·118	6 P. M. −·437	31		
18	−·106	−·368			

In discussing the Solar and Lunar Diurnal Tide involved in the preceding Tables, by the method described in pp. 42–44, the following results were arrived at:—

I.—*Diurnal Tide in Height at High Water.*

1. Maximum value of Lunar Tide for Positive Heights = 0·15 ft.
2. Maximum value of Lunar Tide for Negative Heights = 0·20 ft.
3. Maximum value of Solar Tide = 0·245.
4. Diurnal Solitidal Interval = $3^h\ 28^m$.
5. Age of Lunar Tide = $5^d\ 4^h$.

II.—*Diurnal Tide in Height at Low Water.*

1. Maximum value of Lunar Tide for Positive Heights = 0·23 ft.
2. Maximum value of Lunar Tide for Negative Heights = 0·30 ft.
3. Maximum value of Solar Tide = 0·245 ft.
4. Diurnal Solitidal Interval = $3^h\ 28^m$.
5. Age of Lunar Tide = $4^d\ 17^h$.

Adding together the first two of each of the preceding series of values, we find

Range of Lunar Tide at High Water $= h = 0{\cdot}35$ ft.
Range of Lunar Tide at Low Water $= l = 0{\cdot}53$ ft.

Hence, by equation (3),

$$\cot (m - i_m) = \frac{0{\cdot}350}{0{\cdot}530} = \cot (56^\circ\ 34'),$$

which, converted into time, gives

$$m - i_m = 3^h\ 54^m\ ;$$

but m, the Moon's Hour-angle at High Water in Caherciveen time is $3^h\ 48^m$, and, therefore,

$$i_m = 0^h\ 6^m.$$

By equation (4), we have

$$\text{Max. value of } 2M \sin 2\mu = \sqrt{(0{\cdot}35)^2 + (0{\cdot}53)^2} = 0{\cdot}635 \text{ ft.}$$

From which we obtain

$$M = 0{\cdot}480 \text{ ft.};$$

and since the maximum value of the Solar Tide at High Water is 0·245 ft., we have by equation (5),

$$\text{Max. value of } 2S \sin 2\sigma = 0{\cdot}490 \text{ ft.},$$

therefore,

$$S = 0{\cdot}335 \text{ ft.}$$

Combining together the preceding results, we have the following Tidal Constants for Caherciveen:—

1. Lunitidal Interval $= 0^h\ 6^m$.
2. Solitidal Interval $= 3^h\ 28^m$.
3. Age of Lunar Tide at High Water $= 5^d\ 4^h$.
   Age of Lunar Tide at Low Water $= 4^d\ 17^h$.
4. Lunar Coefficient $= 0{\cdot}480$ ft.
5. Solar Coefficient $= 0{\cdot}335$ ft.
6. Ratio of Solar to Lunar coefficient,

$$\text{or } \frac{S}{M} = 0{\cdot}698.$$

The Solar and Lunar Tides were constructed from the preceding constants, and compared with the observed Tides. The results of this comparison are contained in the following Tables :—

CAHERCIVEEN.—TABLE A.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDES *at Caherciveen at High Water; Positive Heights for Sixteen Lunations, commencing* 1850, *October* 20^d 17^h 30^m, *and ending* 1852, *January* 1^d 11^h 54^m.

No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.
1	0·14	0·16	−0·02
2	0·27	0·20	+0·07
3	0·23	0·24	−0·01
4	0·24	0·29	−0·05
5	0·28	0·27	+0·01
6	0·22	0·21	+0·01
7	0·08	0·08	0·00
8	0·14	0·13	+0·01
9	0·20	0·19	+0·01
10	0·23	0·30	−0·07
11	0·24	0·29	−0·05
12	0·20	0·26	−0·05
13	0·13	0·19	−0·06
14	0·11	0·09	−0·02
15	0·18	0·10	+0·08
16	0·28	0·21	+0·07

Mean Difference = −0·004 ft.

CAHERCIVEEN.—TABLE B.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDES *at Caherciveen at High Water; Negative Heights for Sixteen and one-half Lunations commencing* 1850, *October* 7^d 21^h 6^m, *and ending* 1852, *January* 1^d 11^h 54^m.

No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.
1	0·23	0·22	+0·01
2	0·24	0·22	+0·02
3	0·35	0·24	+0·11
4	0·37	0·37	0·00
5	0·28	0·35	−0·07
6	0·26	0·31	−0·05
7	0·17	0·27	−0·10
8	0·14	0·15	−0·01
9	0·19	0·17	+0·02
10	0·34	0·34	0·00
11	0·38	0·37	+0·01
12	0·36	0·35	+0·01
13	0·27	0·33	−0·06
14	0·25	0·16	+0·09
15	0·14	0·12	+0·02
16	0·28	0·25	+0·03
17	0·31	0·34	−0·03

Mean Difference = 0·000 ft.

The following Tables show the comparison of the Observed and Calculated Diurnal Tide at Low Water at Caherciveen:—

CAHERCIVEEN.—TABLE C.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDE *at Caherciveen at Low Water; Positive Heights for Sixteen and one-half Lunations, commencing* 1850, *October* 9^d 2^h 3^m, *and ending* 1852, *January* 5^d 15^h 6^m.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·27	0·30	−0·03	10	0·41	0·45	−0·04
2	0·40	0·37	+0·03	11	0·40	0·40	0·00
3	0·44	0·43	+0·01	12	0·32	0·31	+0·01
4	0·41	0·44	−0·03	13	0·30	0·27	+0·03
5	0·35	0·37	−0·02	14	0·28	0·28	0·00
6	0·27	0·24	+0·03	15	0·32	0·38	−0·06
7	0·28	0·27	+0·01	16	0·40	0·43	−0·03
8	0·40	0·35	+0·05	17	0·46	0·46	0·00
9	0·42	0·41	+0·01				

Mean Difference = − 0·002 ft.

CAHERCIVEEN.—TABLE D.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDE *at Caherciveen at Low Water; Negative Heights for Sixteen Lunations, commencing* 1850, *October* 24^d 0^h 0^m, *and ending* 1851, *December* 21^d 15^h 30^m.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·36	0·40	−0·04	9	0·52	0·56	−0·04
2	0·55	0·59	−0·04	10	0·63	0·60	+0·03
3	0·51	0·55	−0·04	11	0·45	0·46	−0·01
4	0·37	0·46	−0·09	12	0·40	0·38	+0·02
5	0·43	0·38	+0·05	13	0·32	0·32	0·00
6	0·36	0·31	+0·05	14	0·41	0·37	+0·04
7	0·38	0·36	+0·02	15	0·50	0·50	0·00
8	0·49	0·49	0·00	16	0·55	0·52	+0·03

Mean Difference = − 0·001 ft.

The four preceding Tables, A, B, C, D, show the agreement in height between the Observed and Calculated Tides at Caherciveen. The following Tables, E, F, show the differences of the Observed and Calculated Times of Vanishing of the Diurnal Tide, during the sixteen and one-half Lunations of observation.

CAHERCIVEEN.—TABLE E.

DIFFERENCE *of Observed and Calculated Times of Vanishing of Diurnal Tide at Caherciveen, at High Water, expressed in Lunar Days.*

AGE OF LUNAR TIDE = 5d 4h.

No.	Difference.	No.	Difference.	No.	Difference.	No.	Difference.
	Days.		Days.		Days.		Days.
1	0·00	9	+0·75	17	0·00	25	+0·85
2	-1·75	10	0·00	18	-1·50	26	-1·25
3	0·00	11	+1·75	19	-1·50	27	+1·50
4	0·00	12	0·00	20	0·00	28	0·00
5	+2·00	13	0·00	21	-0·35	29	0·00
6	-0·75	14	0·00	22	0·00	30	+0·50
7	+0·25	15	+2·40	23	0·00	31	-1·00
8	+0·90	16	-3·25	24	-0·50	32	+1·00

Mean Difference = -0·002 Lunar Days.

CAHERCIVEEN.—TABLE F.

DIFFERENCE *of Observed and Calculated Times of Vanishing of Diurnal Tide at Caherciveen, at Low Water, expressed in Lunar Days.*

AGE OF LUNAR TIDE = 4d 17h.

No.	Difference.	No.	Difference.	No.	Difference.	No.	Difference.
	Days.		Days.		Days.		Days.
1	+0·45	10	-2·05	18	+0·45	26	+0·95
2	-0·55	11	-0·15	19	0·00	27	+1·45
3	-0·15	12	-0·95	20	-1·15	28	+0·80
4	+0·45	13	-1·80	21	-1·40	29	+0·80
5	+0·45	14	+0·45	22	-0·40	30	+0·45
6	+0·70	15	+0·05	23	-0·55	31	+0·45
7	+0·45	16	+0·45	24	-0·40	32	-1·05
8	+1·40	17	+0·45	25	-0·15	33	+0·90
9	+0·45						

Mean Difference = -0·003 Lunar Days.

The agreement between the Observed and Calculated Heights and Times shown in the preceding Tables is as close as can be expected in Tidal Observations, and indicates the degree of importance which should be attached to the Diurnal Tidal Constants at Caherciveen, given in page 56.

SECTION V.—DIURNAL TIDE AT BUNOWN.

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
Jan. 4	5.45 P. M.		Feb. 20	+·231	−·162
5	−·325	+·443	21	+·131	+·081
6	−·350	+·562	22	+·043	−·106
7	−·456	+·368	23	−·037	−·125
8	−·256	+·150	24	+·050	−·025
9, 10	−·050	+·587	25	1 P. M. −·187	7.15 P. M. −·118
11	−·181	+·475	26	−·206	+·231
12	+·068	+·187	27	−·287	+·343
13	+·293	6.30 A. M. +·381	28	−·006	+·287
14	−·150	+·275	Mar. 1	+1·300	+·037
15	+·218	+·325	2	−·018	+·087
16	−·200	+·268	3	−·400	+·175
17	−·168	−·262	4	−·200	−·087
18	+·218	−·043	5	6.15 P. M. −·306	+·168
19	+·443	+·162	6	−·375	+·106
20	6.30 A. M. +·312	12.30 P. M. −·231	7	−·175	+·043
21	+·343	−·506	8	−·043	+·368
22	+·381	−·650	9	−·081	+·125
23	+·318	−·375	10, 11	−·162	−·062
24	+·237	−·468	12	−·075	5 A. M. −·187
25	+·262	−·231	13	+·143	−·406
26	−·256	−·037	14	+·093	−·368
27	1 P. M. −·275	7.15 P. M. +·325	15	+·056	−·456
28	−·437	−·100	16	+·050	−·581
29	−·406	+·081	17	+·262	−·462
30	−·500	+·225	18	+·318	−·250
31	−·431	+·231	19	5.30 A. M. −·218	11.30 A. M. −·500
Feb. 1	−·337	+·387	20	−·312	−·450
2	−·275	+·400	21	+·137	+·050
3	6 P. M. −·325	+·250	22	−·081	+·243
4	−·025	+·356	23	+·175	−·056
5	−·168	+·225	24	−·381	+·081
6	−·181	+·512	25	−·325	+·450
7	−·187	+·262	26	12.15 P. M. −·187	6.30 P. M. +·331
8	−·206	+·343	27	−·144	+·381
9, 10	−·262	+·212	28	−·169	+·387
11	−·012	6 A. M. +·131	29	−·137	+·194
12	+·252	−·018	30	−·212	+·412
13	+·268	−·187	31	−·219	+·231
14	+·162	−·237	April 1	−·206	+·018
15	+·212	−·350	2	−·006	+·231
16	+·237	−·631	3	6 P. M. −·087	+·206
17	+·337	−·700	4	−·081	+·106
18	6 A. M. +·381	12.30 P. M. −·450	5	+·025	−·118
19	+·337	−·369	6	+·087	−·168

DIURNAL TIDE AT BUNOWN—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
April 7	+·068	-·193	May 24	Noon. -·056	6.15 P. M. +·406
8	+·093	-·262	25	-·043	+·450
9, 10	+·143	-·362	26	·000	+·287
11	+·012	6.30 A. M. -·475	27	+·062	+·175
12	-·081	-·531	28	+·162	+·137
13	-·093	-·525	29	+·150	+·093
14	-·068	-·431	30	+·168	-·025
15	-·100	-·331	31	+·212	-·112
16	-·062	-·250	June 1	+·218	-·300
17	000	-·106	2	6.15 P. M. +·118	-·518
18	6 A. M. -·025	12.15 P. M. +·037	3	+·100	-·500
19	-·025	+·143	4	+·325	-·525
20	-·262	+·056	5	+·262	-·550
21	-·318	-·331	6	+·025	-·712
22	-·300	+·175	7, 8	+·018	-·693
23	-·212	+·500	9	-·100	6.15 A. M. -·368
24	-·125	+·412	10	-·125	-·325
25	1.15 P. M. -·037	7.15 P. M. +·400	11	-·293	-·350
26	-·050	+·150	12	-·206	-·050
27	+·018	+·281	13	-·387	+·150
28	000	+·293	14	-·381	+·212
29	-·050	+·193	15	-·225	-·031
30	-·043	+·137	16	6 A. M. -·400	Noon. +·218
May 1	+·031	+·025	17	-·487	+·281
2	+·106	-·075	18	-·387	+·456
3	5.45 P. M. +·143	-·143	19	-·400	+·531
4	+·156	-·168	20	-·362	+·506
5	+·162	-·300	21	-·225	+·556
6	+·150	-·456	22	-·231	+·431
7	+·268	-·387	23	Noon. -·050	6 P. M. +·331
8, 9	+·081	-·625	24	-·056	+·200
10	+·018	6.15 A. M. -·675	25	+·162	+·162
11	-·075	-·625	26	+·187	+·087
12	-·150	-·462	27	+·250	-·031
13	-·131	-·312	28	+·318	-·043
14	-·162	-·212	29	+·268	-·231
15	-·131	-·118	30	+·300	-·392
16	-·231	+·025	July 1	6.15 P. M. +·325	-·506
17	5.45 A. M. -·275	11.45 A. M. +·137	2	+·268	-·618
18	-·312	+·256	3	+·250	-·575
19	-·312	+·381	4	+·131	-·581
20	-·375	+·487	5	+·031	-·318
21	-·362	+·462	6, 7	+·012	-·250
22	-·231	+·493	8	-·043	6 A. M. -·350
23	+·118	+·431	9	-·225	-·181

DIURNAL TIDE AT BUNOWN—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
July 10	−·293	−·087	Aug. 25	+·175	−·293
11	−·281	+·206	26	+·281	−·475
12	−·406	+·293	27	+·287	−·412
13	−·462	+·456	28	5.30 P. M. +·256	−·443
14	−·493	+·293	29	+·187	−·450
15	5.45 A. M. −·368	11.45 A. M. +·493	30	+·168	−·331
16	−·456	+·506	31	+·075	−·187
17	−·525	+·450	Sept. 1	+·006	−·087
18	−·443	+·431	2, 3	−·075	−·018
19	−·293	+·512	4	−·206	5.15 A. M. +·125
20	−·306	+·443	5	−·268	+·231
21	−·237	+·418	6	−·337	+·325
22	−·012	+·325	7	−·368	+·350
23	Noon. +·137	6.15 P. M. +·168	8	−·281	+·350
24	+·175	+·062	9	−·318	+·362
25	+·275	−·037	10	−·425	+·318
26	+·318	−·231	11	−·400	+·018
27	+·400	−·287	12	5.30 A. M. −·318	11.30 A. M. +·012
28	+·200	−·187	13	−·343	+·225
29	+·100	−·193	14	−·050	+·137
30	6 P. M. +·337	+·012	15	−·043	−·075
31	+·231	−·212	16	−·093	−·162
Aug. 1	+·237	−·456	17	+·012	+·100
2	+·225	−·268	18	+·100	·000
3, 4	+·143	−·418	19	+·156	−·100
5	+·031	−·300	20	Noon. +·181	6.30 P. M. −·293
6	−·131	6 A. M. −·187	21	+·137	−·406
7	−·268	−·031	22	+·100	−·487
8	−·093	+·156	23	+·131	−·493
9	−·137	+·218	24	+·300	−·193
10	−·450	+·318	25	+·143	−·056
11	−·431	+·331	26	+·118	−·100
12	−·443	+·400	27	6 P. M. +·112	−·193
13	5.30 A. M. −·443	11.30 A. M. +·356	28	−·218	−·006
14	−·456	+·375	29	−·118	−·087
15	−·225	+·343	30	+·262	+·375
16	−·275	+·412	Oct. 1	−·212	+·200
17	−·268	+·381	2, 3	−·512	−·050
18	−·200	+·293	4	−·256	6.30 A. M. +·293
19	−·025	+·331	5	−·287	+·287
20	−·062	+·106	6	−·262	+·362
21	10.45 A. M. +·043	5.15 P. M. −·068	7	−·118	+·406
22	+·150	−·131	8	−·218	+·356
23	+·050	−·256	9	−·131	+·387
24	−·187	−·437	10	−·193	+·206

DIURNAL TIDE AT BUNOWN—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
Oct. 11	5 A. M. −·075	11 A. M. +·425	Nov. 21	−·256	−·387
12	−·237	+·112	22	−·206	−·106
13	−·081	−·006	23	−·331	+·100
14	−·162	−·031	24	−·368	+·275
15	+·200	−·125	25	6 P. M. −·337	+·400
16	+·400	−·250	26	−·318	+·437
17	+·193	−·150	27	−·381	+·112
18	+·118	−·331	28	−·350	+·425
19	+·087	−·606	29, 30	−·331	+·325
20	12.30 P. M. +·131	7 P. M. −·518	Dec. 1	−·156	+·425
21	+·162	−·431	2	−·050	5.45 A. M. +·437
22	−·006	−·418	3	−·068	+·343
23	+·031	−·437	4	+·062	+·068
24	−·018	−·256	5	+·050	+·193
25	−·006	−·200	6	+·125	+·312
26	−·031	−·006	7	+·050	−·006
27	6.15 P. M. −·168	+·118	8	+·093	−·556
28	−·056	+·237	9	+·418	−·281
29	−·181	+·287	10	5.15 A. M. +·318	11.15 A. M. −·056
30	−·331	+·343	11	+·256	−·262
31	+·100	+·318	12	+·368	−·437
Nov. 1, 2	+·293	+·506	13	+·262	−·487
3	−·100	6.45 A. M. +·400	14	+·337	−·487
4	−·037	+·331	15	+·243	−·518
5	−·106	+·356	16	+·112	−·400
6	−·068	+·287	17	11.45 A. M. −·137	6.15 P. M. −·431
7	−·025	+·243	18	−·275	−·381
8	+·012	+·200	19	−·200	−·375
9	+·075	+·043	20	−·150	−·162
10	5 A. M. +·018	11 A. M. −·050	21	−·156	+·237
11	+·056	−·131	22	−·462	+·231
12	+·162	−·200	23	−·400	+·250
13	+·187	−·300	24	6 P. M. −·212	+·437
14	+·200	−·387	25	− 425	+·637
15	+·300	−·456	26	−·450	+·337
16	+·268	−·575	27	−·462	+·187
17	+·125	−·643	28	−·325	+·425
18	Noon. −·025	6.30 P. M. −·712	29	−·268	+·493
19	−·056	−·562	30	−·162	+·418
20	−·212	−·406	31		

Separating the Solar and Lunar Tide in the preceding Tables, by the method described in pp. 42–44, I obtained the following results:—

I.—*Diurnal Tide in Height at High Water.*

1. Maximum value of Lunar Tide for Positive Heights = 0·20 ft.
2. Maximum value of Lunar Tide for Negative Heights = 0·28 ft.
3. Maximum value of Solar Tide = 0·25 ft.
4. Diurnal Solitidal Interval = $2^h\ 52^m$.
5. Age of Lunar Tide = $4^d\ 9^h$.

II.—*Diurnal Tide in Height at Low Water.*

1. Maximum value of Lunar Tide for Positive Heights = 0·30 ft.
2. Maximum value of Lunar Tide for Negative Heights = 0·40 ft.
3. Maximum value of Solar Tide = 0·25 ft.
4. Diurnal Solitidal Interval = $2^h\ 52^m$.
5. Age of Lunar Tide = $4^d\ 9^h$.

Adding the first two of each of the preceding, we find

Range of Lunar Tide at High Water = 0·48 ft.
Range of Lunar Tide at Low Water = 0·70 ft.

Hence, by equation (3),

$$\cot(m - i_m) = \frac{0·48}{0·70} = \cot(55°),$$

or,

$$m - i_m = 3^h\ 47^m\ ;$$

but since m, at High Water, is the Moon's Hour-angle, west of Bunown Meridian, and is $4^h\ 18^m$, we find,

$$i_m = 0^h\ 31^m.$$

By equation (4), we have

$$\text{Max. value of } 2M \sin 2\mu = \sqrt{(0·48)^2 + (0·70)^2} = 0·848 \text{ ft.}$$

From which we obtain

$$M = 0·646 \text{ ft.}\ ;$$

and since the maximum value of the Solar Tide is 0·250 ft., we have by equation (5),

$$\text{Max. value of } 2S \sin 2\sigma = 0·500 \text{ ft.},$$

and, therefore,

$$S = 0·342 \text{ ft.}$$

Combining these results, we have as Tide Constants at Bunown:—

1. Lunitidal Interval $= 0^h\ 31^m$.
2. Solitidal Interval $= 2^h\ 52^m$.
3. Age of Lunar Tide at High Water $= 4^d\ 9^h$.
   Age of Lunar Tide at Low Water $= 4^d\ 9^h$.
4. Lunar Coefficient = 0·646 ft.
5. Solar Coefficient = 0·342 ft.
6. Ratio of Solar to Lunar Coefficient,

$$\text{or } \frac{S}{M} = 0{\cdot}529.$$

The Solar and Lunar Tides at Bunown were constructed from the foregoing Constants, and compared with the observed Tides. The results of the comparison are given in the following Tables :—

BUNOWN.—TABLE A.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDES *at Bunown at High Water; Positive Heights for Thirteen Lunations, commencing* 1851, *January* $10^d\ 16^h\ 42^m$, *and ending* 1851, *December* $31^d\ 11^h\ 36^m$.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·41	0·39	+0·02	8	0·36	0·36	0·00
2	0·38	0·36	+0·02	9	0·25	0·33	−0·08
3	0·29	0·25	+0·04	10	0·21	0·21	0·00
4	0·12	0·13	−0·01	11	0·16	0·13	+0·03
5	0·20	0·20	0·00	12	0·23	0·20	+0·03
6	0·23	0·24	−0·01	13	0·31	0·30	+0·01
7	0·35	0·32	+0·03				
Mean Difference = + 0·006 ft.							

BUNOWN.—TABLE B.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDES *at Bunown at High Water; Negative Heights for Thirteen Lunations, commencing* 1851, *January* $10^d\ 16^h\ 42^m$, *and ending* 1851, *December* $31^d\ 11^h\ 36^m$.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·45	0·48	−0·03	8	0·47	0·47	0·00
2	0·37	0·39	−0·02	9	0·40	0·39	+0·01
3	0·24	0·31	−0·07	10	0·26	0·26	0·00
4	0·30	0·24	+0·06	11	0·14	0·24	−0·10
5	0·37	0·28	+0·09	12	0·35	0·33	+0·02
6	0·43	0·40	+0·03	13	0·40	0·44	−0·04
7	0·49	0·44	+0·05				
Mean Difference = 0·000 ft.							

BUNOWN.—TABLE C.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDES *at Bunown at Low Water; Positive Heights for Thirteen and a half Lunations, commencing* 1851, *January* 2^d 10^h 54^m, *and ending* 1852, *January* 2^d 17^h 39^m.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·50	0·52	-0·02	8	0·51	0·50	+0·01
2	0·38	0·45	-0·07	9	0·41	0·37	+0·04
3	0·23	0·35	-0·12	10	0·35	0·32	+0·03
4	0·40	0·30	+0·10	11	0·40	0·33	+0·07
5	0·40	0·36	+0·04	12	0·41	0·41	0·00
6	0·47	0·48	-0·01	13	0·44	0·50	-0·06
7	0·52	0·55	-0·03	14	0·50	0·52	-0·02

Mean Difference = - 0·003 ft.

BUNOWN.—TABLE D.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDES *at Bunown at Low Water; Negative Heights for Thirteen and a half Lunations, commencing* 1851, *January* 2^d 10^h 54^m, *and ending* 1852, *January* 2^d 17^h 39^m.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·50	0·56	-0·06	8	0·40	0·50	-0·10
2	0·55	0·47	+0·08	9	0·47	0·46	+0·01
3	0·49	0·40	+0·09	10	0·40	0·43	-0·03
4	0·53	0·43	+0·10	11	0·48	0·46	+0·02
5	0·66	0·56	+0·10	12	0·60	0·57	+0·03
6	0·60	0·64	-0·04	13	0·50	0·60	-0·10
7	0·56	0·62	-0·06				

Mean Difference = + 0·003 ft.

BUNOWN.—TABLE E.

DIFFERENCE *of Observed and Calculated Times of Vanishing of Diurnal Tide at Bunown, at High Water, expressed in Lunar Days.*

AGE OF LUNAR TIDE = 4^d 9^h.

No.	Difference.	No.	Difference.	No.	Difference.	No.	Difference.
	Days.		Days.		Days.		Days.
1	-0·25	8	-0·20	15	+0·60	21	+0·80
2	-0·20	9	+0·50	16	-0·20	22	-0·20
3	+1·60	10	-3·00	17	+0·55	23	+0·65
4	-0·20	11	-1·20	18	-0·45	24	-1·20
5	+2·75	12	+1·15	19	-0·25	25	-0·25
6	-0·20	13	-0·20	20	-0·20	26	-0·75
7	+0·75	14	-0·25				

Mean = + 0·001 Lunar Days.

BUNOWN.—TABLE F.

DIFFERENCE *of Observed and Calculated Times of Vanishing of Diurnal Tide at Bunown, at Low Water, expressed in Lunar Days.*

AGE OF LUNAR TIDE = $4^d\ 9^h$.

No.	Difference.	No.	Difference.	No.	Difference.	No.	Difference.
	Days.		Days.		Days.		Days.
1	−0·83	8	−0·53	15	−0·58	21	+0·12
2	−0·03	9	−0·28	16	+0·97	22	+0·37
3	+0·87	10	+0·37	17	−0·58	23	−0·08
4	−0·38	11	−0·43	18	+0·12	24	−0·48
5	+0·62	12	−0·28	19	+1·27	25	−0·53
6	+0·12	13	−0·28	20	−0·30	26	+0·27
7	+0·37	14	−0·08				

Mean = +0·003 Lunar Days.

From the foregoing Tables it will be seen that there is an excellent general agreement between the Observations and the Tides calculated from the Constants determined in p. 65, and that these may, therefore, be relied on as very close approximations to the Constants of the Diurnal Tide at Bunown.

SECTION VI.—DIURNAL TIDE AT RATHMULLAN.

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1850.			1850.		
Nov. 1			Nov. 19	−·112	−·543
2			20	−·456	−1·043
3			21	−·262	−·025
4			22	7.15 A. M. −·131	1.30 P. M. ·000
5	+·143	+·025	23	+·300	+·437
6	−·181	−·337	24	+·243	+·587
7	7.45 P. M. −·131	−·568	25	+·012	−·075
8	−·531	−·125	26	+·356	−·137
9	−·350	·000	27	+·331	−·343
10	+·150	−·131	28	+·325	−·337
11, 12	−·493	−·068	29	3 P.M. +·356	9.15 A. M. −·381
13	−·762	+·043	30	+·231	−·318
14	−·931	8.15 A. M. +·025	Dec. 1	−·087	−·156
15	−·318	+·081	2	−·125	−·243
16	−·175	+·206	3	−·193	+·037
17	−·518	+·137	4	−·650	−·462
18	−·368	+·143	5	−·468	−·456

DIURNAL TIDE AT RATHMULLAN—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1850.			1851.		
Dec. 6	7.30 P. M. −·437	−·212	Jan. 20	7.30 A. M. +·281	1.30 P. M. +·118
7	−·431	−·281	21	+·469	+·187
8	−·500	−·187	22	+·775	+·162
9, 10	−·543	−·037	23	+·543	+·212
11	−·556	−·006	24	+·287	+·037
12	−·637	+·150	25	+·087	+·218
13	−·681	+·268	26	+·206	+·156
14	2 A. M. −·843	8 A. M. −·250	27	3.15 P. M. −·225	9.15 P. M. −·262
15	−·593	−·256	28	−·431	−·693
16	−·162	−·093	29	−·281	−·225
17	−·162	+·231	30	−·425	−·037
18	−·443	−·081	31	−·400	−·056
19	−·062	−·150	Feb. 1	−·350	−·037
20	+·118	+·143	2	−·431	+·031
21	7 A. M. +·318	1.15 P. M. +·212	3	7.15 P. M. −·525	−·093
22	+·256	+·056	4	−·743	+·275
23	+·531	+·068	5	−·612	+·512
24	+·387	−·050	6	−·743	−·125
25	+·412	−·293	7	−·356	−·193
26	+·531	−·193	8	−·562	−·181
27	+·412	−·125	9, 10	−·493	−·125
28	+·100	8 P. M. +·193	11	−·306	7.45 A. M. −·093
29	+·100	−·093	12	−·131	+·025
30	·000	+·050	13	−·162	−·043
31	−·156	+·100	14	−·200	−·062
			15	+·062	−·012
1851.			16	+·200	·000
Jan. 1	−·200	+·093	17	+·456	−·018
2	−·343	−·050	18	7 A. M. +·568	1.30 P. M. +·025
3	−·468	−·312	19	+·493	+·168
4	7 P. M. −·293	−·250	20	+·525	+·218
5	−·543	−·331	21	+·350	+·543
6	−·575	−·331	22	+·562	+·275
7	−·631	−·100	23	+·081	+·237
8	−·450	+·150	24	−·093	+·112
9	−·731	+·812	25	2.30 P. M. −·162	9 P. M. +·025
10	−·693	+·618	26	−·206	−·112
11, 12	−·487	+·200	27	−·325	−·125
13	−·406	7.45 A. M. +·400	28	−·550	−·243
14	−·543	−·093	Mar. 1	−·400	−·112
15	−·056	−·068	2	−·525	−·143
16	−·418	−·181	3	−1·125	−·156
17	+·168	+·112	4	−·512	+·012
18	+·168	−·231	5	7.15 P. M. −·493	−·137
19	+·331	−·187	6	−·343	−·256

Diurnal Tide at Rathmullan—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
Mar. 7	−·162	−·156	April 23	−·481	+·081
8	−·468	+·056	24	−·493	+·156
9	−·300	+·037	25	2.30 P. M. −·506	8.30 P. M. +·150
10, 11	−·175	−·087	26	−·500	·000
12	−·031	6.45 A. M. −·006	27	−·306	+·237
13	−·087	−·168	28	−·400	−·012
14	−·025	−·237	29	−·331	+·019
15	+·156	−·243	30	−·293	−·119
16	+·325	−·050	May 1	−·187	−·018
17	+·312	−·012	2	−·168	+·012
18	−·056	−·025	3	7.30 P. M. −·094	+·068
19	6.45 P. M. +·125	1 P. M. −·012	4	+·075	−·062
20	+·606	+·225	5	+·193	−·175
21	+·200	−·231	6	+·062	+·068
22	−·131	+·075	7	+·043	−·381
23	−·125	+·131	8, 9	+·143	−·400
24	−·187	−·118	10	+·387	7.45 A. M. −·281
25	−·250	+·168	11	+·443	−·306
26	2 P. M. −·212	7.45 P. M. −·018	12	+·337	−·256
27	−·262	+·043	13	+·181	−·143
28	−·450	−·093	14	+·043	+·025
29	−·268	−·006	15	−·043	+·056
30	−·375	−·012	16	−·256	+·075
31	−·243	−·018	17	7 A. M. −·256	1 P. M. +·006
April 1	−·268	+·006	18	−·368	−·006
2	−·212	−·018	19	−·387	+·031
3	7 P. M. −·287	+·012	20	−·518	+·031
4	−·181	−·025	21	−·543	−·112
5	−·093	−·112	22	−·487	+·100
6	−·056	+·025	23	−·531	+·250
7	+·143	+·187	24	1.45 P. M. −·487	7.15 P. M. +·243
8	+·093	+·193	25	−·468	−·056
9, 10	+·043	−·075	26	−·443	−·106
11	+·031	8 A. M. −·187	27	−·162	−·006
12	+·206	−·275	28	−·193	+·337
13	+·150	−·393	29	−·162	+·087
14	+·200	−·168	30	−·075	+·018
15	+·162	−·006	31	+·012	+·100
16	+·087	−·043	June 1	+·031	+·200
17	+·018	−·025	2	7.30 P. M. +·112	+·137
18	7.15 A. M. −·056	1.15 P. M. +·106	3	+·168	−·118
19	−·156	+·175	4	+·306	−·012
20	−·187	+·243	5	+·331	−·093
21	−·306	+·331	6	+·456	−·031
22	−·425	+·081	7, 8	+·468	+·200

DIURNAL TIDE AT RATHMULLAN—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
June 9	+·031	8 A. M. −·268	July 25	−·143	+·037
10	+·325	−·125	26	+·037	+·056
11	+·093	−·075	27	+·100	+·081
12	−·112	+·018	28	+·137	·000
13	−·231	−·162	29	+·293	−·081
14	−·256	−·200	30	7.15 P. M. +·443	−·025
15	−·518	−·081	31	+·162	+·012
16	7.15 A. M. −·387	1.30 P. M. −·143	Aug. 1	+·375	+·075
17	−·337	−·106	2	+·475	+·237
18	−·212	−·062	3	+·512	+·106
19	−·025	−·056	4, 5	+·212	−·081
20	−·575	+·081	6	+·143	7.15 A. M. −·306
21	−·618	+·056	7	−·050	−·125
22	−·606	−·050	8	−·187	−·143
23	1.30 P. M. −·606	7.15 P. M +·037	9	−·493	−·112
24	−·612	+·062	10	−·575	−·237
25	−·406	+·118	11	−·662	−·262
26	−·143	+·087	12	−·756	−·225
27	−·043	+·168	13	6.45 A. M. −·850	12.30 P. M. −·293
28	+·012	+·112	14	−1·062	−·081
29	+·100	+·087	15	−·743	−·162
30	+·162	+·068	16	−·637	−·093
July 1	7.30 P. M. +·300	+·093	17	−·337	+·393
2	+·393	+·043	18	−·400	+·312
3	+·387	+·025	19	−·312	+·106
4	+·337	·000	20	−·137	+·218
5	+·456	−·112	21	12.30 P. M. −·212	6.45 P. M. +·212
6, 7	+·500	+·056	22	+·006	+,037
8	+·443	7.45 A. M. +·131	23	+·012	+·018
9	+·087	−·012	24	+·137	+·300
10	+·031	+·037	25	+·187	·000
11	−·293	+·006	26	+·406	+·087
12	+·275	−·112	27	+·387	+·075
13	+·112	−·318	28	6.45 P. M. +·450	+·043
14	−·031	−·056	29	+·400	−·150
15	7.15 A. M. −·481	1.15 P. M. −·043	30	+·406	+·268
16	−·675	−·131	31	+·218	+·412
17	−·668	−·068	Sept. 1	+·193	−·268
18	−·556	+·025	2, 3	+·081	+·043
19	−·518	−·093	4	−·125	6.30 A. M. +·106
20	−·481	−·006	5	−·025	−·075
21	−·475	+·062	6	−·162	−·068
22	−·512	+·062	7	−·256	−·125
23	2 P. M. −·350	7 P. M. +·100	8	−·643	+·012
24	−·125	+·068	9	−·775	−·175

DIURNAL TIDE AT RATHMULLAN—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
Sept. 10	−·718	−·212	Oct. 26	+·131	+·037
11	−·750	−·175	27	7.30 P. M. −·112	−·043
12	7.15 A. M. −·668	1.15 P. M. −·125	28	−·206	+·162
13	−·556	−·087	29	+·481	+·225
14	−·525	−·050	30	−·475	+·412
15	−·187	+·087	31	−·512	+·081
16	−·125	+·031	Nov. 1, 2	−·156	+·356
17	−·256	−·093	3	−·462	8.30 A. M. −·131
18	−·150	+·156	4	−·587	+·031
19	−·018	+·075	5	−·618	+·031
20	1 P. M. +·118	7.30 P. M. −·162	6	−·556	+·025
21	+·181	−·256	7	−·518	−·050
22	+·300	−·212	8	−·381	+·006
23	+·393	+·143	9	−·500	−·025
24	+·412	+·050	10	6.30 A. M. −·318	12.15 P. M. +·212
25	+·218	−·006	11	−·218	+·512
26	+·350	+·037	12	−·050	+·250
27	7 P. M. +·325	+·018	13	−·018	−·012
28	+·318	+·006	14	+·062	−·243
29	+·381	+·081	15	+·287	−·112
30	−·331	−·200	16	+·256	−·056
Oct. 1	−·531	−·025	17	+·300	−·187
2, 3	−·418	+·012	18	1.45 P. M. +·200	8 P. M. −·287
4	−·006	8 A. M. +·062	19	−·143	+·400
5	+·087	+·081	20	+·168	+·200
6	−·150	−·056	21	+·206	−·037
7	−·200	+·493	22	+·025	−·156
8	−·668	−·012	23	−·068	−·012
9	−·612	+·150	24	−·256	·000
10	−·250	+·412	25	7 P. M. −·281	+·031
11	6.30 A. M. −·406	Noon. +·150	26	−·475	+·043
12	−·512	−·243	27	−·537	−·250
13	−·125	−·100	28	−·475	−·062
14	−·243	−·362	29, 30	−·618	−·200
15	+·131	−·325	Dec. 1	−·718	−·012
16	−·037	+·087	2	−·525	8.30 A. M. +·137
17	+·118	+·112	3	−·543	+·131
18	+·156	−·106	4	−·362	+·131
19	+·218	−·200	5	−·168	+·150
20	2.45 P. M. +·218	8.45 P. M. −·206	6	−·287	+·193
21	+·193	−·350	7	−·181	+·018
22	+·318	−·368	8	+·394	+·350
23	+·456	−·150	9	+·200	+·568
24	+·387	+·031	10	6.15 A. M. −·037	12.30 P. M. +·143
25	+·256	+·043	11	−·068	−·025

DIURNAL TIDE AT RATHMULLAN—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
Dec. 12	+·162	+·156	Dec. 22	−·362	+·118
13	+·250	+·087	23	−·312	·000
14	+·481	+·062	24	6.45 P. M. −·518	+·137
15	+·493	−·068	25	−·606	+·018
16	+·437	−·168	26	−·550	+·012
17	2 P. M. +·418	8 P. M. −·418	27	−·656	−·218
18	+·387	−·406	28	−·687	−·218
19	+·168	−·050	29	−·643	−·125
20	+·118	+·200	30	−·518	
21	−·156	+·025	31		

From the preceding Tables I obtained, by the method described in pp. 42–44, the following results:—

I.—*Diurnal Tide at High Water.*

1. Maximum value of Lunar Tide for Positive Heights = 0·29 ft.
2. Maximum value of Lunar Tide for Negative Heights = 0·47 ft.
3. Maximum value of Solar Tide = 0·23 ft.
4. Diurnal Solitidal Interval = 9^h 40^m.
5. Age of Lunar Tide = 5^d 10^h.

II.—*Diurnal Tide at Low Water.*

1. Maximum value of Lunar Tide for Positive Heights = 0·13 ft.
2. Maximum value of Lunar Tide for Negative Heights = 0·20 ft.
3. Maximum value of Solar Tide = 0·23 ft.
4. Diurnal Solitidal Interval = 9^h 40^m.
5. Age of Lunar Tide = 4^d 20^h.

Adding together the first two of each of the preceding series of values, we find,

Range of Lunar Tide at High Water = 0·76 ft.
Range of Lunar Tide at Low Water = 0·33 ft.

Hence, by equation (3),

$$\cot(m - i_m) = \frac{0{\cdot}76}{0{\cdot}33} = \cot(23^\circ\ 28'),$$

which, converted into time, gives

$$m - i_m = 1^h\ 37^m;$$

but m, the Moon's Hour-angle at High Water, is, in Rathmullan time, $5^h\ 43^m$; and, therefore,

$$i_m = 4^h\ 6^m.$$

By equation (4), we have

$$\text{Maximum value of } 2M \sin 2\mu = \sqrt{(0{\cdot}76)^2 + (0{\cdot}33)^2} = 0{\cdot}829 \text{ ft.}$$

From which we obtain

$$M = 0{\cdot}632 \text{ ft.};$$

and since the maximum value of the Solar Tide is 0·23 ft., we have by equation (5),

$$\text{Max. value of } 2S \sin 2\sigma = 0{\cdot}46 \text{ ft.},$$

and, therefore,

$$S = 0{\cdot}315 \text{ ft.}$$

Combining together the preceding results, we obtain the following Diurnal Tidal Constants for Rathmullan:—

1. Lunitidal Interval = $4^h\ 6^m$.
2. Solitidal Interval = $9^h\ 40^m$.
3. Age of Lunar Tide at High Water = $5^d\ 10^h$.
   Age of Lunar Tide at Low Water = $4^d\ 20^h$.
4. Lunar Coefficient = 0·632 ft.
5. Solar Coefficient = 0·315 ft.
6. Ratio of Solar to Lunar Coefficient,

$$\text{or } \frac{S}{M} = 0{\cdot}498.$$

The Solar and Lunar Tides were carefully constructed from the preceding Constants, and compared with the observed Tides. The results of this comparison are given in the six following Tables:—

RATHMULLAN.—TABLE A.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDES *at Rathmullan at High Water; Positive Heights for Fifteen Lunations, commencing* 1850, *November* 5d 12h 21m, *and ending* 1851, *December* 22d 10h 45m.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·34	0·42	−0·08	9	0·45	0·49	−0·04
2	0·50	0·53	−0·03	10	0·45	0·46	−0·01
3	0·57	0·49	+0·08	11	0·44	0·36	+0·08
4	0·55	0·43	+0·12	12	0·40	0·31	+0·09
5	0·32	0·31	+0·01	13	0·40	0·32	+0·08
6	0·20	0·31	−0·11	14	0·30	0·39	−0·09
7	0·40	0·39	+0·01	15	0·44	0.48	−0·04
8	0·40	0·50	−0·10				

Mean Difference = − 0·002 ft.

RATHMULLAN.—TABLE B.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDES *at Rathmullan at High Water; Negative Heights for Fifteen and one-half Lunations, commencing* 1850, *November* 5d 12h 21m, *and ending* 1852, *January* 5d 9h 45m.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet,		Feet.	Feet.	Feet.
1	0·58	0·61	−0·03	9	0·60	0·67	−0·07
2	0·70	0·67	+0·03	10	0·60	0·67	−0·07
3	0·62	0·69	−0·07	11	0·83	0·59	+0·24
4	0·60	0·67	−0·07	12	0·74	0·52	+0·22
5	0·72	0·51	+0·21	13	0·44	0·51	−0·07
6	0·36	0·49	−0·13	14	0·57	0·60	−0·03
7	0·50	0·57	−0·07	15	0·62	0·67	−0·05
8	0·55	0·64	−0·09	16	0·68	0·67	+0·01

Mean Difference = − 0·003 ft.

RATHMULLAN.—TABLE C.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDES *at Rathmullan at Low Water; Positive Heights for Fifteen Lunations, commencing* 1850, *November* 6d 16h 15m, *and ending* 1851, *December* 21d 4h 30m.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·14	0·09	+0·05	9	0·14	0·17	−0·03
2	0·10	0·15	−0·05	10	0·11	0·20	−0·09
3	0·13	0·19	−0·06	11	0·21	0·24	−0·03
4	0·26	0·23	+0·03	12	0·13	0·16	−0·03
5	0·06	0·18	−0·12	13	0·15	0·16	−0·01
6	0·20	0·06	+0·14	14	0·18	0·10	+0·08
7	0·21	0·10	+0·11	15	0·19	0·22	−0·03
8	0·10	0·10	0·00				

Mean Difference = − 0·003 ft.

RATHMULLAN.—TABLE D.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDES *at Rathmullan at Low Water; Negative Heights for Fifteen and one-half Lunations, commencing* 1850, *November* 6^d 16^h 15^m, *and ending* 1852, *January* 4^d 8^h 30^m.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·13	0·07	+0·06	9	0·16	0·16	0·00
2	0·40	0·23	+0·17	10	0·14	0·24	-0·10
3	0·11	0·20	-0·09	11	0·26	0·28	-0·02
4	0·10	0·23	-0·13	12	0·20	0·24	-0·04
5	0·20	0·23	-0·03	13	0·03	0·14	-0·11
6	0·13	0·20	-0·07	14	0·18	0·09	+0·09
7	0·25	0·08	+0·17	15	0·12	0·12	0·00
8	0·30	0·10	+0·20	16	0·16	0·23	-0·07
Mean Difference = + 0·002 ft.							

The preceding Tables, A, B, C, D, show the agreement in height between the Observed and Calculated Tides at Rathmullan. The following Tables, E, F, show the differences between the Observed and Calculated Times of Vanishing, during the fifteen and one-half Lunations.

RATHMULLAN.—TABLE E.

DIFFERENCE *of Observed and Calculated Times of Vanishing of Diurnal Tide at Rathmullan, at High Water, expressed in Lunar Days.*

AGE OF LUNAR TIDE = 5^d 10^h.

No.	Difference.	No.	Difference.	No.	Difference.	No.	Difference.
	Days.		Days.		Days.		Days.
1	+0·43	9	-1·17	17	-2·07	25	+2·03
2	+2·93	10	+1·93	18	+0·43	26	+1·63
3	-1·27	11	-1·77	19	+2·13	27	+0·93
4	-0·07	12	+0·43	20	+0·43	28	+2·43
5	+1·37	13	-1·27	21	-1·77	29	-0·67
6	-0·93	14	+0·43	22	-0·07	30	-0·67
7	+2·57	15	-1·57	23	-0·97	31	+1·27
8	-1·63	16	+0·43	24	-0·57		
Mean Difference = + 0·001 Lunar Days.							

RATHMULLAN.—TABLE F.

DIFFERENCE *of Observed and Calculated Times of Vanishing of Diurnal Tide at Rathmullan, at Low Water, expressed in Lunar Days.*

AGE OF LUNAR TIDE = $4^d\ 20^h$.

No.	Difference.	No.	Difference.	No.	Difference.	No.	Difference.
	Days.		Days.		Days.		Days.
1	−1·0	9	+0·3	17	−1·7	25	−3·7
2	+2·4	10	+2·3	18	+1·6	26	+0·3
3	−1·4	11	+0·3	19	+0·3	27	+2·7
4	+0·3	12	+0·3	20	+0·3	28	−0·7
5	−0·4	13	+0·3	21	−2·2	29	+0·3
6	+2·3	14	−2·7	22	−1·7	30	+0·3
7	−3·7	15	+1·3	23	−1·3	31	+1·0
8	+3·8	16	+0·3	24	−0·7		
Mean Difference = −0·016 Lunar Days.							

Although the agreement between the Observed and Calculated Tides, shown by the preceding six Tables, is not so close as in some of the other Stations, yet it is sufficiently so to warrant us in relying upon the Tide Constants here determined, as close approximations to the truth.

SECTION VII.—DIURNAL TIDE AT PORTRUSH.

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water..
1850.			1850.		
Nov. 1	+·331	−·175	Nov. 21	−·337	+·100
2	+·200	+·150	22	7.30 A. M. −·137	1.45 P. M. −·087
3	+·162	+·056	23	+·218	+·168
4	+·093	−·243	24	+·193	+·487
5	+·175	·000	25	+·031	−·137
6	−·218	−·268	26	+·400	−·275
7	7.45 P. M. −·275	−·081	27	+·325	−·300
8	−·518	−·068	28	+·318	−·337
9	−·456	−·018	29	8.15 P. M. +·350	9.45 P. M. −·331
10, 11	−·612	+·031	30	+·193	−·218
12	−·631	+·075	Dec. 1	+·081	−·075
13	−·675	+·137	2	−·056	−·143
14	−·562	9 A. M. +·100	3	−·206	+·068
15	−·462	+·106	4	−·668	−·412
16	−·381	+·187	5	−·450	−·412
17	−·406	+·050	6	7.30 P. M. −·475	−·200
18	−·231	+·093	7	−·425	−·243
19	+·031	+·625	8	−·487	−·375
20	−·375	+·018	9	−·525	−·287

DIURNAL TIDE AT PORTRUSH—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1850.			1851.		
Dec. 10	−·668	+·068	Jan. 24	+·256	+·112
11, 12	−·581	+·068	25	+·156	+·218
13	−·693	+·106	26	+·137	+·112
14	−·656	8.15 A. M. −·387	27	4.15 P. M. −·156	9.30 P. M. −·200
15	−·406	−·181	28	−·162	−·700
16	−·143	+·137	29	−·068	−·337
17	−·262	+·006	30	−·212	−·225
18	−·425	−·100	31	−·306	−·131
19	−·031	−·118	Feb. 1	−·318	−·081
20	+·068	+·212	2	−·393	−·037
21	7.15 A. M. +·375	1.45 P. M. +·306	3	7.30 P. M. −·518	−·118
22	+·312	+·181	4	−·637	+·150
23	+·393	+·187	5	−·600	+·256
24	+·181	+·006	6	−·743	−·112
25	+·325	−·468	7	−·356	−·150
26	+·537	−·212	8	−·118	−·118
27	+·437	−·218	9, 10	−·456	−·137
28	8 P. M. +·006	9.30 P. M. −·250	11	−·106	9.15 A. M. −·093
29	+·181	−·237	12	−·006	·000
30	+·187	+·081	13	−·143	−·081
31	−·218	+·418	14	−·125	−·062
			15	+·068	+·068
1851.			16	+·212	−·081
Jan. 1	−·475	+·437	17	+·400	+·062
2	−·418	−·025	18	7.30 A. M. +·518	2 P. M. +·375
3	−·406	−·300	19	+·412	+·356
4	8 P. M. −·256	−·100	20	+·312	+·331
5	−·412	−·212	21	+·218	+·300
6, 7	−·481	−·356	22	+·162	+·212
8	−·550	−·231	23	+·075	+·112
9	−·450	−·175	24	+·006	+·062
10	−·406	+·362	25	4.15 P. M. −·150	9.45 P. M. −·025
11	−·612	+·118	26	−·175	−·156
12	−·406	+·206	27	−·293	−·168
13	−·387	8.45 A. M. +·512	28	−·468	−·218
14	−·518	+·018	Mar. 1	−·400	−·243
15	−·043	+·012	2	−·356	−·218
16	−·362	−·687	3	−·306	−·193
17	+·181	−·325	4	−·281	+·062
18	+·237	−·043	5	8 P. M. −·518	−·150
19	+·281	+·118	6	−·262	−·243
20	8.15 A. M. +·112	2.30 P. M. +·175	7	−·043	−·125
21	+·343	+·131	8	−·306	·000
22	+·825	+·268	9	−·293	+·006
23	+·393	+·368	10, 11	−·275	−·206

DIURNAL TIDE AT PORTRUSH—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
March			April 26	−·418	+·068
12	+·012	8.45 A. M. −·293	27	−·350	−·006
13	+·050	−·287	28	−·412	−·018
14	+·143	−·200	29	−·243	+·037
15	+·250	−·206	30	−·237	+·006
16	+·218	−·100	May 1	−·156	+·068
17	+·256	+·062	2	7.15 P. M. −·293	+·056
18	−·006	+·068	3	−·131	+·062
19	7 A. M. +·162	1.30 P. M. −·093	4	+·037	+·137
20	+·525	+·500	5	+·037	+·050
21	+·093	+·393	6	+·037	−·037
22	− 106	+·193	7	+·087	−·125
23	−·118	+·206	8, 9	+·187	−·418
24	−·037	+·212	10	+·368	9.15 A. M. −·206
25	−·093	+·368	11	+·425	−·106
26	3.30 A. M. −·312	9.45 P. M. +·075	12	+·237	−·181
27	−·262	+·125	13	+·156	−·093
28	−·381	−·037	14	+·062	+·056
29	−·256	+·012	15	−·031	+·106
30	−·350	−·162	16	−·137	·000
31	−·325	−·075	17	7 A. M. −·175	1 P. M. −·100
April 1	−·250	+·025	18	−·275	−·006
2	−·175	+·075	19	−·256	−·006
3	7 P. M. −·356	+·012	20	−·337	−·025
4	−·206	−·037	21	−·606	−·106
5	−·131	−·056	22	−·525	+·043
6	−·093	+·006	23	−·562	+·125
7	−·075	−·025	24	3.30 P. M. −·487	8.30 P. M. +·112
8	+·025	−·093	25	−·425	+·087
9, 10	+·156	−·268	26	−·506	−·075
11	+·225	9.15 A. M. −·337	27	−·343	−·075
12	+·243	−·262	28	−·262	+·037
13	+·131	−·318	29	−·231	+·100
14	+·168	−·187	30	−·193	+·043
15	+·193	−·056	31	−·100	+·093
16	+·137	−·006	June 1	+·018	+·200
17	−·081	+·031	2	8 P. M. +·012	+·287
18	7.15 A. M. −·100	1.45 A. M. +·068	3	+·187	−·018
19	−·168	+·206	4	+·331	+·037
20	−·100	+·225	5	+·243	−·093
21	−·243	+·325	6	+·337	−·268
22	−·462	+·100	7, 8	+·312	+·093
23	−·431	+·118	9	+·050	9.15 A. M. −·300
24	−·418	+·262	10	+·337	−·087
25	4 P. M. −·462	9.15 P. M. +·200	11	+·168	−·031

Diurnal Tide at Portrush—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.		
June 12	−·112	+·012
13	−·318	−·112
14	−·306	−·043
15	−·518	−·118
16	7.30 A. M. −·337	2 P. M. −·212
17	+·337	+·106
18	+·031	−·043
19	−·418	−·118
20	−·612	−·006
21	−·600	+·087
22	−·581	−·093
23	3.15 P. M. −·612	8.30 P. M. −·062
24	−·456	−·043
25	−·318	+·018
26	−·150	−·018
27	−·037	+·043
28	+·012	+·118
29	+·043	+·106
30	+·156	+·206
July 1	8 P. M. +·456	+·300
2	+·525	+·150
3	+·362	+·112
4	+·387	+·056
5	+·418	−·087
6, 7	+·487	−·212
8	+·487	9 A. M. −·137
9	+·150	−·062
10	+·050	−·075
11	−·312	+·081
12	−·456	·000
13	−·575	−·181
14	−·381	−·093
15	7.15 A. M. −·531	1.15 P. M. −·168
16	−·456	−·300
17	−·543	−·337
18	−·425	−·256
19	−·512	−·143
20	−·556	−·081
21	−·493	−·018
22	−·500	+·075
23	3.15 P. M. −·425	8.45 P. M. +·025
24	−·275	+·031
25	−·212	·000
26	−·025	−·050
27	+·025	−·025
1851.		
July 28	+·056	+·006
29	+·325	+·100
30	7.15 P. M. +·331	+·250
31	+·331	+·112
Aug. 1	+·468	+·200
2	+·400	+·312
3	+·337	+·118
4, 5	+·218	−·050
6	+·193	8.30 A. M. −·137
7	+·025	−·093
8	−·250	−·131
9	−·437	−·131
10	−·537	−·256
11	−·562	−·262
12	−·556	−·293
13	7 A. M. −·525	1 P. M. −·350
14	−·493	−·218
15	−·443	+·112
16	−·462	−·175
17	−·293	−·162
18	−·350	−·093
19	−·331	+·062
20	−·475	+·037
21	2.15 P. M. −·118	8.45 P. M. +·175
22	+·137	+·050
23	+·156	−·081
24	+·112	−·093
25	+·075	−·075
26	+·200	−·006
27	+·256	+·206
28	7 P. M. +·375	+·462
29	+·237	+·312
30	+·312	+·325
31	+·193	+·200
Sept. 1	+·068	+·093
2, 3	+·075	+·087
4	+·025	8.30 A. M. −·006
5	−·137	−·237
6	−·187	−·062
7	−·481	−·093
8	−·618	−·281
9	−·925	−·187
10	−·725	−·243
11	−·587	−·250
12	7 A. M. −·556	1 P. M. −·250

DIURNAL TIDE AT PORTRUSH—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
Sept. 13	−·475	−·231	Oct. 29	−·250	+·006
14	−·412	−·156	30	+·043	+·081
15	−·312	−·106	31	−·237	−·018
16	−·256	−·006	Nov. 1, 2	−·431	+·243
17	−·193	+·025	3	−·500	9 A. M. +·068
18	−·162	+·031	4	−·293	+·025
19	−·025	−·037	5	−·375	+·018
20	3.15 P. M. +·037	9.15 P. M. −·181	6	−·375	−·037
21	+·093	−·275	7	−·381	−·056
22	+·293	−·218	8	−·393	−·012
23	+·287	−·050	9	−·331	−·018
24	+·281	+·206	10	6.15 A. M. −·131	12.30 P. M. +·037
25	+·068	+·018	11	−·137	+·062
26	+·325	+·093	12	−·106	+·068
27	7.30 P. M. +·293	+·181	13	−·075	+·112
28	+·156	+·200	14	−·012	+·081
29	+·206	+·062	15	+·250	−·075
30	−·262	−·625	16	+·162	−·137
Oct. 1	−·431	−·106	17	+·281	−·193
2, 3	−·331	−·031	18	8 P. M. +·281	9.30 P. M. −·312
4	+·018	8.45 A. M. +·156	19	+·306	−·125
5	−·212	+·025	20	+·093	−·006
6	−·425	−·018	21	+·206	−·156
7	−·300	+·143	22	−·012	−·162
8	−·356	−·100	23	+·056	+·012
9	−·425	−·018	24	·000	+·056
10	−·450	−·162	25	7.30 P. M. −·087	+·050
11	6.30 A. M. −·425	12.45 P. M. ·000	26	−·287	+·006
12	−·281	−·218	27	−·418	−·143
13	−·075	−·100	28	−·568	−·056
14	−·093	−·368	29, 30	−·781	+·043
15	+·206	−·356	Dec. 1	−·806	+·006
16	+·100	+·106	2	−·443	8 A. M. +·131
17	−·006	+·050	3	−·500	+·150
18	+·112	−·150	4	−·525	+·125
19	+·237	−·256	5	−·237	+·056
20	4 P. M. +·006	9.45 P. M. −·225	6	−·281	+·062
21	+·075	−·287	7	−·350	−·200
22	+·231	−·243	8	+·900	+·243
23	+·281	−·031	9	+·312	+·537
24	+·262	+·075	10	7.15 A. M. ·000	1.30 P. M. +·237
25	+·112	+·006	11	−·143	+·012
26	+·162	+·081	12	−·056	+·143
27	7.45 P. M. −·056	+·025	13	+·125	−·031
28	+·025	+·187	14	+·356	−·037

DIURNAL TIDE AT PORTRUSH—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
Dec. 15	+·475	-·093	Dec. 24	7.15 P. M. -·443	-·006
16	+·443	-·237	25	-·512	-·150
17	2 P. M. +·287	8.45 P. M. -·387	26	-·331	-·181
18	+·312	-·293	27	-·300	-·150
19	+·056	-·081	28	-·568	-·093
20	-·043	·000	29	-·537	-·093
21	-·318	+·018	30		
22	-·256	-·087	31		
23	-·043	-·093			

From the data contained in the preceding Tables the Solar and Lunar Diurnal Tides at Portrush were obtained separately, as before, and found to give the following results:—

I.—*Diurnal Tide at High Water.*

1. Maximum value of Lunar Tide for Positive Heights = 0·22 ft.
2. Maximum value of Lunar Tide for Negative Heights = 0·37 ft.
3. Maximum value of Solar Tide = 0·25 ft.
4. Diurnal Solitidal Interval = $11^h\ 30^m$.
5. Age of Lunar Tide = $5^d\ 9^h$.

II.—*Diurnal Tide at Low Water.*

1. Maximum value of Lunar Tide for Positive Heights = 0·15 ft.
2. Maximum value of Lunar Tide for Negative Heights = 0·19 ft.
3. Maximum value of Solar Tide = 0·25 ft.
4. Diurnal Solitidal Interval = $11^h\ 30^m$.
5. Age of Lunar Tide = $4^d\ 19^h$.

Adding the first two of each of the preceding, we obtain

Range of Lunar Tide at High Water = 0·59 ft.
Range of Lunar Tide at Low Water = 0·34 ft.

Hence, by equation (3),

$$\cot(m - i_m) = \frac{0{\cdot}59}{0{\cdot}34} = \cot(29^\circ\ 57'),$$

or, converting the arc into time,

$$m - i_m = 2^h\ 4^m\ ;$$

but since m is the Moon's Hour-angle, in Portrush time, at High Water, and is equal to $5^h\ 47^m$, we have, finally

$$i_m = 3^h\ 43^m.$$

By equation (4), we have

$$\text{Max. value of } 2M \sin 2\mu = \sqrt{(0{\cdot}59)^2 + (0{\cdot}34)^2} = 0{\cdot}681 \text{ ft.}$$

From which we obtain

$$M = 0{\cdot}519 \text{ ft.}$$

Also, since the maximum value of the Solar Tide is 0·25 ft., we have

$$\text{Max. value of } 2S \sin 2\sigma = 0{\cdot}500 \text{ ft.},$$

and,

$$S = 0{\cdot}342 \text{ ft.}$$

Combining these results, we have for Tide Constants at Portrush:—

1. Lunitidal Interval = $3^h\ 43^m$.
2. Solitidal Interval = $11^h\ 30^m$.
3. Age of Lunar Tide at High Water = $5^d\ 9^h$.
   Age of Lunar Tide at Low Water = $4^d\ 19^h$.
4. Lunar Coefficient = 0·519 ft.
5. Solar Coefficient = 0·342 ft.
6. Ratio of Solar to Lunar Coefficient,—

$$\frac{S}{M} = 0{\cdot}659.$$

The Theoretical Tides were constructed with the foregoing Constants, and compared with the observed Tides. The results of the comparison are given in the six following Tables :—

PORTRUSH.—TABLE A.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDES *at Portrush at High Water; Positive Heights for Fifteen Lunations, commencing* 1850, *November* $7^d\ 7^h\ 45^m$, *and ending* 1851, *December* $22^d\ 5^h\ 35^m$.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·35	0·39	-0·04	9	0·50	0·45	+0·05
2	0·40	0·44	-0·04	10	0·41	0·41	0·00
3	0·47	0·43	+0·04	11	0·32	0·26	+0·06
4	0·40	0·29	+0·11	12	0·30	0·24	+0·06
5	0·30	0·24	+0·06	13	0·28	0·29	-0·01
6	0·22	0·26	-0·04	14	0·30	0·38	-0·08
7	0·30	0·34	-0·04	15	0·41	0·45	-0·04
8	0·33	0·44	-0·11				

Mean Difference = -0·001 ft.

PORTRUSH.—TABLE B.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDES *at Portrush at High Water; Negative Heights for Fifteen Lunations, commencing* 1850, *November* $7^d\ 7^h\ 45^m$, *and ending* 1851, *December* $22^d\ 5^h\ 35^m$.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·64	0·57	+0·07	9	0·57	0·59	-0·02
2	0·65	0·62	+0·03	10	0·52	0·57	-0·05
3	0·50	0·59	-0·09	11	0·56	0·51	+0·05
4	0·58	0·57	+0·01	12	0·70	0·42	+0·28
5	0·38	0·41	-0·03	13	0·43	0·41	+0·02
6	0·33	0·39	-0·06	14	0·42	0·51	-0·09
7	0·42	0·46	-0·04	15	0·58	0·57	+0·01
8	0·52	0·56	-0·04	16	0·55	0·57	-0·02

Mean Difference = + 0·002 ft.

PORTRUSH.—TABLE C.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDES *at Portrush at Low Water; Positive Heights for Fifteen Lunations, commencing* 1850, *November* 6^{d} 15^{h} 24^{m}, *and ending* 1851, *December* 21^{d} 16^{h} 30^{m}.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·18	0·13	+0·05	9	0·17	0·28	−0·11
2	0·23	0·18	+0·05	10	0·20	0·32	−0·12
3	0·22	0·27	−0·05	11	0·25	0·26	−0·01
4	0·35	0·31	+0·04	12	0·13	0·17	−0·04
5	0·27	0·22	+0·05	13	0·14	0·07	+0·07
6	0·24	0·09	+0·15	14	0·10	0·15	−0·05
7	0·10	0·05	+0·05	15	0·18	0·25	−0·07
8	0·16	0·15	+0·01				

Mean Difference = + 0·001 ft.

PORTRUSH.—TABLE D.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDES *at Portrush at Low Water; Negative Heights for Fifteen Lunations, commencing* 1850, *November* 6^{d} 15^{h} 24^{m}, *and ending* 1851, *December* 21^{d} 16^{h} 30^{m}.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·16	0·10	+0·06	9	0·18	0·27	−0·09
2	0·32	0·21	+0·11	10	0·30	0·33	−0·03
3	0·20	0·27	−0·07	11	0·28	0·32	−0·04
4	0·20	0·34	−0·14	12	0·23	0·27	−0·04
5	0·21	0·28	−0·07	13	0·10	0·11	−0·01
6	0·27	0·19	+0·08	14	0·20	0·14	+0·06
7	0·30	0·07	+0·23	15	0·16	0·19	−0·03
8	0·17	0·15	+0·02	16	0·23	0·29	−0·06

Mean Difference = − 0·001 ft.

PORTRUSH.—TABLE E.

DIFFERENCE *of Observed and Calculated Times of Vanishing of Diurnal Tide at Portrush, at High Water, expressed in Lunar Days.*

AGE OF LUNAR TIDE = 5^{d} 9^{h}.

No.	Difference.	No.	Difference.	No.	Difference.	No.	Difference.
	Days.		Days.		Days.		Days.
1	+0·1	9	+1·8	17	−1·4	25	−0·4
2	+1·7	10	+1·5	18	+0·3	26	−0·2
3	−1·9	11	−1·7	19	−1·5	27	+0·3
4	+0·7	12	+1·8	20	+0·6	28	+3·3
5	−1·3	13	−1·4	21	−1·7	29	+0·3
6	+0·5	14	+0·9	22	−0·5	30	+3·5
7	−1·9	15	−1·4	23	−1·2	31	−1·9
8	−0·9	16	+1·3	24	+1·3		

Mean = + 0·020 Lunar Days.

PORTRUSH.—TABLE F.

DIFFERENCE *of Observed and Calculated Times of Vanishing of Diurnal Tide at Portrush, at Low Water, expressed in Lunar Days.*

AGE OF LUNAR TIDE = $4^d\ 19^h$.

No.	Difference.	No.	Difference.	No.	Difference.	No.	Difference.
	Days.		Days.		Days.		Days.
1	−4·1	9	+7·3	17	+0·3	25	−9·1
2	−4·0	10	+5·9	18	−2·9	26	+11·3
3	+0·3	11	−4·1	19	+0·4	27	+2·3
4	−1·1	12	+8·8	20	−0·1	28	−6·1
5	−2·1	13	+9·3	21	−0·9	29	−4·6
6	+0·9	14	−4·6	22	+0·3	30	−4·7
7	+4·8	15	−4·6	23	−0·2	31	−1·7
8	+2·3	16	−4·8	24	+5·3		
Mean = −0·006 Lunar Days.							

The agreement of the Observed and Calculated Tides, shown in Tables A, B, C, D, E is very good; but the differences in Table F are very great; they do not, however, vitiate the accuracy of our Tidal Constants for Portrush, and probably owe their origin to the fact that the Diurnal Tide at Low Water at this station was so small in amount, that a very slight error of Observation would produce a considerable error in the Time of Vanishing. The agreement between Theory and Observation, as respects the Height of the Diurnal Tide at Low Water, is excellent.

SECTION VIII.—DIURNAL TIDE AT CUSHENDALL.

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
Jan. 1			Jan. 10	−·350	+·587
2			11	−·343	+·275
3			12	+·112	+·437
4	11.45 P.M. −·443	+·043	13	6.30 A.M. +·118	12.15 P.M. +1·131
5	−·487	+·237	14	−·443	+·643
6	−·575	+·112	15	+·256	+·262
7	−·706	+·181	16	−·293	−·062
8, 9	−·456	+·443	17	+·112	−·518

DIURNAL TIDE AT CUSHENDALL—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
Jan. 18	+·250	−·381	Mar. 6	−·331	+·118
19	+·237	−·181	7	−·037	−·106
20	12.30 P. M. +·368	6.30 P. M. −·281	8	−·025	−·162
21	+·431	−·643	9	−·112	+·193
22	+·812	−·743	10	−·318	−·043
23	+·781	−·450	11	−·112	−·256
24	+·600	−·362	12	4.30 A. M. +·218	11 A. M. −·143
25	+·606	+·206	13	+·143	−·018
26	+·450	+·018	14	+·125	−·181
27	7.15 P. M. +·150	+·043	15	+·268	−·350
28	−·293	−·312	16	+·381	−·381
29	−·225	−·043	17	+·518	−·412
30	−·225	+·312	18	+·462	−·218
31	−·193	+·175	19	11.45 A. M. +·337	5.45 P. M. −·656
Feb. 1	−·137	+·218	20	+·837	−·056
2	−·287	5.15 A. M. +·362	21	+·568	−·075
3	−·493	+·187	22	+·293	−·106
4	−·393	+·318	23	+·406	−·012
5	−·306	+·125	24	+·300	+·268
6	−·593	+·425	25	+·168	+·462
7	−·475	+·162	26	6 P. M. −·093	+·268
8	−·275	+·187	27	−·012	+·562
9, 10	−·081	+·112	28	−·131	+·062
11	5.30 A. M. −·143	11.30 A. M. +·018	29	−·193	+·368
12	+·131	+·143	30	−·250	+·243
13	+·212	+·081	31	−·106	+·168
14	+·187	−·056	April 1, 2	+·062	+·218
15	+·368	−·168	3	−·006	5 A. M. +·162
16	+·400	−·550	4	−·093	+·087
17	+·650	−·687	5	−·050	+·012
18	12.15 P. M. +·900	6 P.M. −·506	6	+·025	−·162
19	+·831	−·562	7	+·106	−·162
20	+·718	−·387	8	+·200	−·200
21	+·662	−·187	9	+·268	−·287
22	+·481	−·212	10	+·012	−·343
23	+·337	−·050	11	5.30 A. M. −·037	12.15 P. M. −·387
24	+·168	+·087	12	+·312	−·468
25	6.15 P. M. +·087	+·206	13	+·356	−·506
26	−·093	+·275	14	+·387	−·537
27	−·256	+·306	15	+·468	−·468
28	−·350	+·318	16	+·418	−·387
Mar. 1	−·300	+·181	17	+·362	−·094
2	−·375	+·125	18	12.15 P. M. +·312	6 P. M. +·068
3, 4	−·368	+·050	19	+·206	+·131
5	−·187	5.30 A. M. +·343	20	+·106	+·150

Diurnal Tide at Cushendall—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
April 21	+·162	+·368	June 7	+·475	−·768
22	−·137	+·281	8	+·587	−·450
23	−·243	+·381	9	6.15 A. M. +·156	12.30 P. M. −·556
24	−·168	+·525	10	+·425	−·506
25	6.45 P. M. −·131	+·637	11	+·400	−·493
26	−·200	+·543	12	+·256	−·181
27	−·193	+·437	13	+·006	−·037
28	−·175	+·306	14	·000	+·175
29	−·081	+·218	15	−·193	+·287
30	−·081	+·100	16	12.30 P. M. −·318	6 P. M. +·256
May 1, 2	−·025	−·075	17	−·106	+·300
3	+·106	5.15 A. M. −·131	18	−·368	+·156
4	+·143	−·237	19	−·475	+·187
5	+·212	−·281	20	−·475	+·375
6	+·337	−·393	21	−·400	+·443
7	+·412	−·431	22	−·287	+·275
8	+·375	−·350	23	5.45 P. M. −·056	+·431
9	+·275	−·481	24	+·056	+·593
10	5.15 A. M. +·350	Noon. −·543	25	+·025	+·562
11	+·387	−·637	26	+·075	+·287
12	+·412	−·581	27	+·200	+·193
13	+·400	−·468	28	+·237	+·050
14	+·393	−·412	29, 30	+·337	−·131
15	+·406	−·150	July 1	+·437	5.15 A. M. −·350
16	+·206	+·043	2	+·387	−·318
17	Noon. −·012	5.30 A. M. +·056	3	+·387	−·493
18	−·131	+·075	4	+·500	−·687
19	−·181	+·143	5	+·618	−·618
20	−·356	+·443	6	+·625	−·581
21	−·537	+·293	7	+·481	−·581
22	−·393	+·175	8	6 A. M. +·412	12.15 P. M. −·443
23	−·218	+·331	9	+·262	−·212
24	5.45 P. M. −·081	+·525	10	+·268	−·200
25	−·075	+·512	11	+·268	+·156
26	−·168	+·343	12	−·075	+·306
27	−·043	+·256	13	−·325	+·306
28	−·012	+·300	14	−·181	+·312
29	·000	+·287	15	11.45 A. M. −·256	5.30 P. M. +·431
30, 31	+·062	+·093	16	−·550	+·406
June 1	+·168	−·093	17	−·643	+·312
2	+·325	5.30 A. M. −·237	18	−·593	+·243
3	+·343	−·231	19	−·525	+·175
4	+·293	−·637	20	−·587	+·118
5	+·650	−·506	21	−·331	+·162
6	+·600	−·462	22	−·156	+·262

DIURNAL TIDE AT CUSHENDALL—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
July 23	6 P. M. +·018	+·362	Sept. 8	−·200	+·462
24	+·043	+·412	9	−·125	+·450
25	+·112	+·287	10	−·200	−·025
26	+·225	+·118	11	−·093	+·156
27	+·225	+·018	12	11.45 A. M. −·356	5.15 P. M. +·206
28, 29	+·231	−·287	13	−·418	+·156
30	+·406	5 A. M. −·568	14	−·381	+·100
31	+·493	−·518	15	−·312	+·087
Aug. 1	+·481	−·687	16	−·200	+·075
2	+·706	−·706	17	−·106	−·012
3	+·806	−·468	18	+·062	−·006
4	+·656	−·400	19	+·187	+·012
5	+·481	−·293	20	5.30 P. M. +·268	−·118
6	5.30 A. M. +·337	Noon. −·118	21	+·200	−·275
7	+·137	+·018	22	+·293	−·462
8	−·043	+·100	23	+·431	−·493
9	−·150	+·181	24	+·512	−·231
10	−·256	+·268	25, 26	+·175	−·381
11	−·268	+·293	27	+·481	5 A. M. −·431
12	−·431	+·231	28	+·500	−·443
13	11.45 A. M. −·143	5.15 A. M. +·193	29	+·456	−·425
14	+·075	+·231	30	+·468	−·300
15	−·450	+·206	Oct. 1	+·043	+·318
16	−·487	+·181	2	−·293	+·243
17	−·350	+·050	3	−·300	+·187
18	−·368	+·050	4	5.45 A. M. −·025	12.15 P. M. +·431
19	−·156	+·212	5	−·050	+·456
20	−·156	+·006	6	−·037	+·468
21	5.15 P. M. +·256	+·125	7	+·200	+·712
22	+·406	+·250	8	−·293	+·431
23	+·293	−·125	9	−·294	+·394
24	+·525	−·318	10	−·281	+·156
25	+·350	−·262	11	11.30 A. M. −·062	4.45 A. M. +·594
26, 27	+·356	−·325	12	−·450	+·131
28	+·506	4.15 A. M. −·475	13	−·193	−·162
29	+·675	−·587	14	−·268	−·506
30	+·600	−·537	15	−·081	−·681
31	+·731	−·525	16	+·243	−·318
Sept. 1	+·606	−·368	17	+·243	−·237
2	+·525	−·193	18	+·425	−·256
3	+·425	+·025	19	+·581	−·437
4	5 A. M. +·106	11.30 A. M. +·143	20	6.30 P. M. +·418	−·375
5	−·125	+·125	21	+·237	−·518
6	−·156	+·318	22	+·356	−·618
7	−·243	+·456	23	+·443	−·625

DIURNAL TIDE AT CUSHENDALL—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide Low Water.
1851.			1851.		
Oct. 24	+·493	−·506	Nov. 28	−·506	+·537
25	+·431	−·331	29, 30	−·581	+·443
26	+·275	5.15 A. M. −·181	Dec. 1	−·575	+·431
27	−·012	−·062	2	5.30 A. M. −·318	11.30 A. M. +·693
28	+·043	+·131	3	−·206	+·693
29	−·256	+·218	4	−·112	+·593
30	−·287	+·481	5	+·006	+·437
31	−·275	+·337	6	+·018	+·462
Nov. 1, 2	−·037	+·525	7	−·225	−·318
3	6.45 A. M. −·362	1 P. M. +·537	8	−·062	−·587
4	−·150	+·462	9	+·268	+·175
5	−·162	+·575	10	11.30 A. M. +·462	5.15 P. M. −·150
6	−·325	+·437	11	+·343	−·375
7	−·243	+·362	12	+·518	−·381
8	−·131	+·243	13	+·493	−·525
9	−·206	+·200	14	+·575	−·568
10	11 A. M. +·006	5 P. M. +·125	15	+·593	−·550
11	+·206	+·050	16	+·475	−·806
12	+·250	−·143	17	6 P. M. +·443	−·731
13	+·300	−·212	18	+·518	−·543
14	+·193	−·343	19	+·375	−·368
15	+·287	−·487	20	+·400	+·012
16	+·512	−·543	21	+·237	+·237
17	+·625	−·606	22	−·118	+·181
18	6 P. M. +·487	−·718	23	−·312	4.45 A. M. +·193
19	+·581	−·650	24	−·243	+·512
20	+·456	−·468	25	−·562	+·425
21	+·181	−·556	26	−·593	+·187
22	+·175	−·481	27	−·525	+·262
23	+·212	−·231	28	−·537	+·331
24	−·081	5 A. M. +·050	29	−·468	+·343
25	−·143	+·043	30		
26	−·262	+·300	31		
27	−·481	+·487			

The Solar and Lunar Diurnal Tides at Cushendall were calculated from the preceding figures, and found to be as follows :—

I.—*Diurnal Tide at High Water.*

1. Maximum value of Lunar Tide for Positive Heights = 0·50 ft.
2. Maximum value of Lunar Tide for Negative Heights = 0·33 ft.
3. Maximum value of Solar Tide = 0·30 ft.
4. Diurnal Solitidal Interval = $11^h\ 25^m$.
5. Age of Lunar Tide = $6^d\ 18^h\ 41^m$.

II.—*Diurnal Tide at Low Water.*

1. Maximum value of Lunar Tide for Positive Heights = 0·355 ft.
2. Maximum value of Lunar Tide for Negative Heights = 0·45 ft.
3. Maximum value of Solar Tide = 0·25 ft.
4. Diurnal Solitidal Interval = $11^h\ 25^m$.
5. Age of Lunar Tide = $5^d\ 2^h\ 45^m$.

Adding the first two of each of the preceding results, we find,

Range of Lunar Tide at High Water = 0·83 ft.
Range of Lunar Tide at Low Water = 0·805 ft.

Hence, by equation (3),

$$\cot(m - i_m) = \frac{0·830}{0·805} = \cot(44° \ 7'),$$

or, converting the arc into time,

$$m - i_m = 3^h\ 2^m\ ;$$

but since m, the Moon's Hour-angle at High Water, expressed in Cushendall time is $10^h\ 18^m$; we obtain,

$$i_m = 7^h\ 16^m.$$

By equation (4), we have

$$\text{Maximum value of } 2M \sin 2\mu = \sqrt{(0·83)^2 + (0·805)^2} = 1·156 \text{ ft.}$$

From which we obtain

$$M = 0·881 \text{ ft.}\ ;$$

also, since the mean value of the Solar Tide is 0·275 ft., we have,

$$\text{Max. value of } 2S \sin 2\sigma = 0{\cdot}550 \text{ ft.},$$

and,

$$S = 0{\cdot}376 \text{ ft.}$$

Combining the foregoing results, we find for the Tide Constants at Cushendall:—

1. Lunitidal Interval = $7^h\ 16^m$.
2. Solitidal Interval = $11^h\ 25^m$.
3. Age of Lunar Tide at High Water = $6^d\ 18^h\ 41^m$.
   Age of Lunar Tide at Low Water = $5^d\ 2^h\ 45^m$.
4. Lunar Coefficient = 0·881 ft.
5. Solar Coefficient = 0·376 ft.
6. Ratio of Solar to Lunar Coefficient,

$$\text{or } \frac{S}{M} = 0{\cdot}427.$$

The Theoretical Tides were constructed with the foregoing Constants, and compared with the observed Tides. The results of this comparison are contained in the following Tables:—

CUSHENDALL.—TABLE A.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDES *at Cushendall at High Water; Positive Heights for Thirteen Lunations, commencing* 1851, *January* $2^d\ 22^h\ 33^m$, *and ending* 1851 *December* $23^d\ 9^h\ 54^m$.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·70	0·64	+0·06	8	0·70	0·70	0·00
2	0·73	0·70	+0·03	9	0·66	0·68	−0·02
3	0·54	0·52	+0·02	10	0·48	0·52	−0·02
4	0·40	0·34	+0·06	11	0·45	0·43	+0·02
5	0·40	0·40	0·00	12	0·51	0·51	0·00
6	0·50	0·50	0·00	13	0·58	0·60	−0·02
7	0·52	0·63	−0·11				
Mean Difference = 0·000 ft.							

CUSHENDALL.—TABLE B.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDES *at Cushendall at High Water; Negative Heights for Thirteen and one-half Lunations, commencing* 1851, *January* $2^d\ 22^h\ 33^m$, *and ending* 1852, *January* $6^d\ 2^h\ 30^m$.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·56	0·50	+0·06	8	0·59	0·58	+0·01
2	0·50	0·55	−0·05	9	0·50	0·53	−0·03
3	0·36	0·44	−0·08	10	0·38	0·37	+0·01
4	0·20	0·23	−0·03	11	0·20	0·23	−0·03
5	0·20	0·28	−0·08	12	0·33	0·29	+0·04
6	0·40	0·35	+0·05	13	0·53	0·43	+0·10
7	0·47	0·43	+0·04	14	0·55	0·58	−0·03
Mean Difference = −0·001 ft.							

CUSHENDALL.—TABLE C.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDES *at Cushendall at Low Water; Positive Heights for Thirteen Lunations, commencing* 1851, *January* $0^d\ 14^h\ 15^m$, *and ending* 1851, *December* $22^d\ 3^h\ 33^m$.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·62	0·52	+0·10	8	0·40	0·49	−0·09
2	0·31	0·39	−0·08	9	0·28	0·40	−0·12
3	0·30	0·33	−0·03	10	0·40	0·36	+0·04
4	0·40	0·36	+0·04	11	0·57	0·43	+0·14
5	0·56	0·52	+0·04	12	0·54	0·50	+0·04
6	0·45	0·54	−0·09	13	0·61	0·57	+0·04
7	0·52	0·57	−0·05				
Mean Difference = −0·001 ft.							

CUSHENDALL.—TABLE D.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDES *at Cushendall at Low Water; Negative Heights for Thirteen Lunations, commencing* 1851, *January* $0^d\ 14^h\ 15^m$, *and ending* 1851, *December* $22^d\ 3^h\ 33^m$.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·54	0·52	+0·02	8	0·65	0·54	+0·11
2	0·57	0·51	+0·06	9	0·50	0·47	+0·03
3	0·37	0·40	−0·03	10	0·47	0·49	−0·02
4	0·52	0·53	−0·01	11	0·57	0·54	+0·03
5	0·54	0·59	−0·05	12	0·60	0·64	−0·04
6	0·60	0·69	−0·09	13	0·72	0·69	+0·03
7	0·60	0·67	−0·07				
Mean Difference = −0·002 ft.							

CUSHENDALL.—TABLE E.

DIFFERENCE *of Observed and Calculated Times of Vanishing of Diurnal Tide at Cushendall, at High Water, expressed in Lunar Days.*

AGE OF LUNAR TIDE = $6^d\ 18^h\ 41^m$.

No.	Difference.	No.	Difference.	No.	Difference.	No.	Difference.
	Days.		Days.		Days.		Days.
1	+1·32	8	+0·92	15	-0·08	21	-0·68
2	-0·08	9	-0·78	16	+0·42	22	-0·88
3	-0·08	10	+0·52	17	-0·68	23	-0·58
4	+0·22	11	-0·08	18	+0·32	24	-0·08
5	+1·22	12	+0·52	19	-0·58	25	-0·08
6	+1·22	13	-1·58	20	-0·08	26	-0·08
7	-1·58	14	+1·42				

Mean Difference = + 0·004 Days.

CUSHENDALL.—TABLE F.

DIFFERENCE *of Observed and Calculated Times of Vanishing of Diurnal Tide at Cushendall, at Low Water, expressed in Lunar Days.*

AGE OF LUNAR TIDE = $5^d\ 2^h\ 45^m$.

No.	Difference.	No.	Difference.	No.	Difference.	No.	Difference.
	Days.		Days.		Days.		Days.
1	+0·55	8	-0·65	15	+1·05	21	-1·25
2	+0·55	9	-1·85	16	-0·75	22	+0·55
3	+1·55	10	+0·05	17	+0·55	23	+0·55
4	+0·55	11	-0·05	18	-1·05	24	+0·55
5	-0·85	12	-0·45	19	+1·55	25	+0·55
6	-0·45	13	+0·55	20	+1·85	26	-1·65
7	-1·05	14	-0·45				

Mean Difference = 0·000 Lunar Days.

From the preceding Tables it is evident that the utmost reliance may be placed in the values of the Tide Constants at this Station.

SECTION IX.—DIURNAL TIDE AT DONAGHADEE.

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1850.			1850.		
Oct. 3	+·347	+·253	Nov. 18	−·025	+·168
4	+·328	−·409	19	+·725	+·787
5	+·162	+·069	20	+·125	·000
6	+·278	+·522	21	+·181	+·225
7	+·715	+·059	22	12.15 P. M. +·056	6.45 P. M. − 012
8	+·390	6 A. M. −·053	23	+·250	−·556
9	+·260	7 A. M. −·050	24	+·625	−·331
10	+·090	−·115	25	+·318	−·400
11	−·047	−·134	26	+·525	−·668
12	−·156	+·206	27	+·343	−·700
13	−·231	+·312	28	+·337	−·637
14	−·470	+·597	29	7.30 P. M. +·306	−·537
15	−·740	+·453	30	+·362	−·081
16	7.30 A. M. −·487	1.45 P. M. +·444	Dec. 1	+1·068	−·169
17	8.30 A. M. −·190	2.45 P. M. +·675	2	+·243	−·206
18	−·340	+·628	3	+·381	+·300
19	−·200	+·753	4, 5	−·387	+·212
20	−·260	+·412	6	−·512	6 A. M. +·118
21	−·110	+·203	7	−·481	+·312
22	−·040	+·322	8	−·362	+·337
23	−·150	+·019	9	+·081	+·143
24	12.30 P. M. −·012	6.45 P. M. −·006	10	−·281	+·375
25	+·070	−·203	11	−·481	+·475
26	+·169	−·412	12	−·381	+·568
27	+·053	−·244	13	−·337	+·968
28	+·053	−·403	14	6.15 A. M. −·675	12.30 P. M. +·550
29	+·256	−·578	15	−·231	−·431
30	+5·65	−·515	16	+·187	−·618
31	8 P. M. +·394	−·244	17	+·312	−·493
Nov. 1, 2	+·093	−·475	18	−·043	+·056
3	+·156	−·506	19	−·037	+·181
4	−·018	−·056	20	+·275	−·031
5	−·650	−·006	21	Noon. +·493	6.30 P. M. −·425
6	−·175	+·056	22	+·525	−·437
7	−·590	6.30 A. M. +·140	23	+·587	−·443
8	−·284	+·428	24	+·393	−·312
9	−·212	+·340	25	+·143	−·781
10	−·321	+·440	26	+·537	−·681
11	−·431	+·481	27	+·562	−·468
12	−·303	+·450	28	8 P. M. +·087	−·075
13	−·325	+·534	29	000	−·287
14	7.15 A. M. −·315	1 P. M. +·637	30	+·587	−·137
15	−·075	+·656	31	+·493	+·256
16	+·006	+·643			
17	−·181	+·487			

DIURNAL TIDE AT DONAGHADEE—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
Jan. 1	+·525	+·512	Feb. 17	+·593	−·662
2, 3	+·056	+·200	18	12.30 P. M. +·825	6.45 P. M. −·400
4	−·500	5.45 A. M. +·156	19	+·762	−·337
5	−·443	+·137	20	+·681	−·287
6	−·493	+·243	21	+·556	−·200
7	−·637	+·256	22	+·250	−·093
8	−·731	+·343	23	+·250	+·025
9	−·468	+·612	24	+·131	+·156
10	−·368	+·800	25	7 P. M. +·025	+·268
11	−·362	+·518	26	−·100	+·268
12	−·162	+·531	27	−·281	+·256
13	7 A. M. +·100	1 P. M. +1·225	28	−·362	+·225
14	−·381	+·631	Mar. 1	−·493	+·131
15	+·362	+·218	2	−·425	+·112
16	−·193	+·206	3, 4	−·356	+·112
17	+·231	−·381	5	−·193	6 A. M. +·400
18	+·318	−·475	6	−·437	+·131
19	+·456	−·275	7	−·381	−·093
20	12.45 P. M. +·337	7 P. M. −·281	8	−·081	−·075
21	+·400	−·581	9	−·243	+·362
22	+·812	−·743	10	−·425	+·025
23	+·693	−·368	11	−·162	−·262
24	+·131	−·356	12	5 A. M. +·150	11.30 A. M. −·112
25	+·512	+·181	13	−·031	−·037
26	+·350	+·018	14	+·056	−·225
27	7.45. P M. +·112	+·087	15	+·181	−·331
28	−·300	−·437	16	+·318	−·368
29	−·281	−·143	17	+·450	−·337
30	−·181	+·387	18	+·343	−·081
31	−·112	+·181	19	Noon. +·325	6 P. M. −·400
Feb. 1, 2	−·100	−·281	20	+·800	−·100
3	−·343	6 A. M. +·537	21	+·587	+·012
4	−·556	+·287	22	+·281	−·050
5	−·543	+·437	23	+·312	−·006
6	−·581	+·331	24	+·231	+·306
7	−·700	+·462	25	+·100	+·493
8	−·487	+·181	26	6.45 P. M. −·006	+·268
9	−·331	+·187	27	−·012	+·381
10	−·350	+·150	28	−·143	+·375
11	5.45 A. M. −·081	11.45 A. M. +·075	29	−·181	+·412
12	+·062	+·168	30	−·362	+·225
13	+·081	+·025	31	−·181	+·156
14	+·137	−·043	April 1, 2	+·062	+·243
15	+·275	−·162	3	−·025	6 A. M. +·193
16	+·306	−·512	4	−·137	+·143

DIURNAL TIDE AT DONAGHADEE—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
April 5	−·118	+·093	May 21	−·525	+·200
6	−·037	−·100	22	−·337	·000
7	+·037	−·093	23	−·168	+·437
8	+·118	−·143	24	6.30 P. M. −·112	+·606
9	+·156	−·250	25	−·087	+·556
10	+·206	−·281	26	−·125	+·368
11	6.15 A. M. +·106	12.45 P. M. −·337	27	−·018	+·287
12	+·212	−·450	28	+·006	+·325
13	+·225	−·500	29	·000	+·287
14	+·275	−·487	30, 31	+·056	+·081
15	+·325	−·418	June 1	+·137	−·056
16	+·356	−·356	2	+·168	6 A. M. −·131
17	+·231	−·031	3	+·237	−·218
18	12.30 P. M. +·212	6.30 A. M. +·093	4	+·156	−·568
19	+·225	+·237	5	+·581	−·518
20	·000	+·237	6	+·531	−·531
21	−·031	+·462	7	+·362	−·793
22	−·168	+·368	8	+·462	−·550
23	−·225	+·412	9	6.30 A. M. +·062	1.15 P. M. −·731
24	−·200	+·618	10	+·331	−·512
25	7.15 P. M. −·168	+·662	11	+·287	−·481
26	−·150	+·568	12	+·100	−·100
27	−·187	+·425	13	−·056	+·025
28	−·193	+·281	14	+·006	+·243
29	−·056	+·206	15	−·193	+·431
30	−·093	+·125	16	12.30 P. M. −·281	6.30 P. M. +·293
May 1, 2	−·012	−·037	17	−·393	+·356
3	+·075	5.30 A. M. −·031	18	−·362	+·393
4	+·075	−·137	19	−·393	+·275
5	+·118	−·212	20	−·512	+·506
6	+·187	−·331	21	−·462	+·543
7	+·293	−·443	22	−·293	+·387
8	+·343	−·300	23	6 P. M. −·093	+·537
9	+·256	−·456	24	−·056	+·600
10	5.30 A. M. +·218	12.15 P. M. −·637	25	−·025	+·493
11	+·318	−·668	26	+·075	+·250
12	+·318	−·506	27	+·187	+·193
13	+·293	−·400	28	+·206	+·043
14	+·281	−·318	29, 30	+·256	−·106
15	+·243	−·112	July 1	+·406	5.45 A. M. −·331
16	+·231	+·043	2	+·518	−·418
17	Noon. +·118	6.15 A. M. +·056	3	+·506	−·568
18	+·012	+·131	4	+·581	−·612
19	−·075	+·225	5	+·600	−·587
20	−·350	+·450	6	+·543	−·487

Diurnal Tide at Donaghadee—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
July 7	+·450	−·443	Aug. 22	+·381	+·218
8	6.15 A. M. +·331	12.30 P. M. −·418	23	+·268	−·187
9	+·200	−·262	24	+·450	−·393
10	+·093	−·137	25	+·200	−·293
11	−·118	+·218	26, 27	+·225	−·337
12	−·118	+·331	28	+·537	5.30 A. M. −·506
13	−·406	+·381	29	+·687	−·425
14	−·250	+·368	30	+·650	−·331
15	Noon. −·243	6 P. M. +·450	31	+·650	−·387
16	−·556	+·381	Sept. 1	+·543	−·337
17	−·656	+·350	2	+·431	−·243
18	−·625	+·293	3	+·375	+·006
19	−·518	+·212	4	5.30 A. M. +·081	Noon. +·106
20	−·631	+·231	5	−·137	+·087
21	−·412	+·293	6	−·168	+·350
22	−·262	+·337	7	−·243	+·437
23	6.30 P. M. −·037	+·400	8	−·300	+·481
24	+·018	+·381	9	−·431	+·462
25	+·062	+·237	10	−·443	+·268
26	+·175	+·056	11	−·437	+·275
27	+·206	+·056	12	11.45 A. M. −·462	5.30 P. M. +·268
28, 29	+·218	−·243	13	−·443	+·206
30	+·368	5.30 A. M. −·487	14	−·368	+·131
31	+·387	−·412	15	−·337	+·106
Aug. 1	+·231	−·600	16	−·206	+·131
2	+·593	−·606	17	−·106	+·039
3	+·706	−·443	18	+·068	+·081
4	+·606	−·443	19	+·006	·000
5	+·481	−·343	20	6 P. M. −·087	−·143
6	5.45 A. M. +·306	Noon. −·212	21	−·118	−·318
7	+·075	−·018	22	+·243	−·475
8	−·093	+·118	23	+·368	−·443
9	−·200	+·231	24	+·450	−·139
10	−·293	+·312	25, 26	+·262	−·231
11	−·343	+·312	27	+·450	6 A. M. −·350
12	−·462	+·312	28	+·418	−·325
13	11.45 A. M. −·443	5.45 P. M. +·243	29	+·381	−·343
14	−·456	+·275	30	+·368	−·350
15	−·543	+·218	Oct. 1	−·456	+·256
16	−·418	+·268	2	−·425	+·281
17	−·256	+·212	3	−·325	+·325
18	−·037	+·150	4	5.30 A. M. −·037	Noon. +·481
19	−·156	+·281	5	−·093	+·506
20	−·156	+·181	6	−·112	+·525
21	6.15 P. M. +·268	+·156	7	+·137	+·831

DIURNAL TIDE AT DONAGHADEE—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
Oct. 8	−·300	+·450	Nov. 20	+·350	−·362
9	−·300	+·443	21	+·081	−·462
10	−·306	+·206	22	+·087	−·331
11	11.30 A. M. −·150	5.15 P. M. +·593	23, 24	+·243	−·137
12	−·475	+·150	25	−·037	6 A. M. +·106
13	−·075	−·200	26	−·218	+·100
14	−·231	−·500	27	−·325	+·318
15	−·062	−·562	28	−·456	+·400
16	+·325	−·262	29	−·531	+·525
17	+·187	−·225	30	−·406	+·525
18	+·325	−·237	Dec. 1	−·331	+·537
19	+·506	−·437	2	6 A. M. −·350	Noon. +·700
20	7.15 P. M. +·325	−·406	3	−·256	+·693
21	+·175	−·550	4	−·156	+·612
22	+·237	−·656	5	−·006	+·462
23	+·362	−·568	6	−·081	+·425
24	+·337	−·393	7	−·406	−·193
25, 26	+·312	6 A. M. −·218	8	+·387	−·325
27	+·231	−·100	9	+·687	+·181
28	−·012	−·087	10	Noon. +·306	5.45 P. M. −·081
29	−·325	−·143	11	+·081	−·275
30	−·656	·000	12	+·400	−·318
31	−·368	+·531	13	+·362	−·431
Nov. 1	−·293	+·400	14	+·562	−·525
2	−·068	+·618	15	+·712	−·568
3	7 A. M. −·387	1 P. M. +·587	16	+·412	−·781
4	−·093	+·362	17	6 P. M. +·318	−·825
5	−·206	+·631	18	+·375	−·587
6	−·293	+·443	19	+·287	−·300
7	−·243	+·337	20	+·343	+·050
8	−·181	+·293	21	+·250	+·287
9	−·343	+·175	22, 23	−·156	+·293
10	11.30 A. M. −·043	5.15 P. M. +·175	24	−·281	5.15 A. M. +·150
11	+·143	+·168	25	−·237	+·437
12	+·275	−·100	26	−·543	+·425
13	+·293	−·137	27	−·587	+·225
14	+·206	−·243	28	−·550	+·268
15	+·275	−·443	29	−·643	+·350
16	+·418	−·581	30	−·312	+·300
17	+·575	−·706	31		
18	6.30 P. M. +·462	−·787			
19	+·487	−·662			

From the preceding Tables the Solar and Lunar Diurnal Tides at Donaghadee were calculated separately, and found to give the following results:—

I.—*Diurnal Tide at High Water.*

1. Maximum value of Lunar Tide for Positive Heights = 0·42 ft.
2. Maximum value of Lunar Tide for Negative Heights = 0·38 ft.
3. Maximum value of Solar Tide = 0·28 ft.
4. Diurnal Solitidal Interval = $11^h\ 12^m$.
5. Age of Lunar Tide = $6^d\ 5^h$.

II.—*Diurnal Tide at Low Water.*

1. Maximum value of Lunar Tide for Positive Heights = 0·39 ft.
2. Maximum value of Lunar Tide for Negative Heights = 0·42 ft.
3. Maximum value of Solar Tide = 0·28 ft.
4. Diurnal Solitidal Interval = $11^h\ 12^m$.
5. Age of Lunar Tide = $5^d\ 2^h$.

Adding the first two of each of the preceding, we obtain

Range of Lunar Tide at High Water = 0·80 ft.
Range of Lunar Tide at Low Water = 0·81 ft.

Hence, by equation (3),

$$\cot(m - i_m) = \frac{0{\cdot}80}{0{\cdot}81} = \cot(45^\circ\ 21'),$$

or, converting the arc into time,

$$m - i_m = 3^h\ 7^m\ ;$$

but since m is the Moon's Hour-angle, in Donaghadee time, at High Water, and is $10^h\ 40^m$, we obtain, finally,

$$i_m = 7^h\ 33^m.$$

By equation (4), we have

$$\text{Max. value of } 2M \sin 2\mu = \sqrt{(0{\cdot}80)^2 + (0{\cdot}81)^2} = 1{\cdot}139 \text{ ft.}$$

From which we obtain

$$M = 0·868 \text{ ft.}$$

Also, since the maximum value of the Solar Tide is 0·28 ft., we have, by equation (5),

$$\text{Max. value of } 2S \sin 2\sigma = 0·56 \text{ ft.,}$$

and,

$$S = 0·383 \text{ ft.}$$

Combining these results, we have for the Tide Constants at Donaghadee:—

1. Lunitidal Interval = $7^h\ 33^m$.
2. Solitidal Interval = $11^h\ 12^m$.
3. Age of Lunar Tide at High Water = $6^d\ 5^h$.
   Age of Lunar Tide at Low Water = $5^d\ 2^h$.
4. Lunar Coefficient = 0·868 ft.
5. Solar Coefficient = 0·383 ft.
6. Ratio of Solar to Lunar Coefficient,—

$$\text{or } \frac{S}{M} = 0·441.$$

The Theoretical Tides at Donaghadee were constructed with the foregoing Tide Constants, and compared with the Observed Tides, with the following results:—

DONAGHADEE.—TABLE A.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDES *at Donaghadee at High Water; Positive Heights for Sixteen and a half Lunations, commencing* 1850, *September* $29^d\ 5^h\ 51^m$, *and ending* 1851, *December* $22^d\ 22^h\ 24^m$.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·40	0·37	+0·03	10	0·41	0·45	−0·04
2	0·26	0·30	−0·04	11	0·60	0·52	+0·08
3	0·43	0·40	+0·03	12	0·60	0·65	−0·05
4	0·47	0·45	+0·02	13	0·58	0·59	−0·01
5	0·57	0·59	−0·02	14	0·40	0·42	−0·02
6	0·63	0·59	+0·04	15	0·37	0·38	−0·01
7	0·50	0·49	+0·01	16	0·50	0·43	+0·07
8	0·30	0·32	−0·02	17	0·46	0·52	−0·06
9	0·33	0·35	−0·02				

Mean Difference = −0·000 ft.

DONAGHADEE.—TABLE B.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDES *at Donaghadee at High Water; Negative Heights for Seventeen Lunations, commencing* 1850, *September* 29^d 5^h 51^m, *and ending* 1852, *January* 5^d 21^h 12^m.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·39	0·28	+0·11	10	0·48	0·48	0·00
2	0·40	0·31	+0·09	11	0·60	0·58	+0·02
3	0·45	0·46	-0·01	12	0·50	0·56	-0·06
4	0·59	0·54	+0·05	13	0·47	0·48	-0·01
5	0·60	0·58	+0·02	14	0·32	0·33	-0·01
6	0·44	0·48	-0·04	15	0·34	0·29	+0·05
7	0·24	0·37	-0·13	16	0·46	0·38	+0·08
8	0·24	0·31	-0·07	17	0·56	0·55	+0·01
9	0·34	0·40	-0·06				
Mean Difference = + 0·002 ft.							

DONAGHADEE.—TABLE C.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDES *at Donaghadee at Low Water; Positive Heights for Sixteen Lunations, commencing* 1850, *October* 12^d 4^h, *and ending* 1851, *December* 22^d 16^h 27^m.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·60	0·46	+0·14	9	0·44	0·59	-0·15
2	0·62	0·57	+0·05	10	0·55	0·64	-0·09
3	0·61	0·62	-0·01	11	0·48	0·57	-0·09
4	0·70	0·62	+0·08	12	0·36	0·52	-0·16
5	0·35	0·43	-0·08	13	0·46	0·39	+0·07
6	0·26	0·43	-0·17	14	0·60	0·42	+0·18
7	0·42	0·41	+0·01	15	0·59	0·51	+0·08
8	0·57	0·50	+0·07	16	0·65	0·61	+0·04
Mean Difference = – 0·002 ft.							

DONAGHADEE.—TABLE D.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDES *at Donaghadee at Low Water; Negative Heights for Sixteen Lunations, commencing* 1850, *October* 12^d 4^h, *and ending* 1851, *December* 22^d 16^h 27^m.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·46	0·55	-0·09	9	0·66	0·68	-0·02
2	0·66	0·66	0·00	10	0·60	0·64	-0·04
3	0·55	0·67	-0·12	11	0·60	0·52	+0·08
4	0·60	0·54	+0·06	12	0·45	0·47	-0·02
5	0·51	0·52	+0·01	13	0·40	0·42	-0·02
6	0·35	0·42	-0·07	14	0·60	0·47	+0·13
7	0·49	0·46	+0·03	15	0·72	0·62	+0·10
8	0·59	0·57	+0·02	16	0·74	0·67	+0·07
Mean Difference = + 0·006 ft.							

DONAGHADEE.—TABLE E.

DIFFERENCE *of Observed and Calculated Times of Vanishing of Diurnal Tide at Donaghadee, at High Water, expressed in Lunar Days.*

AGE OF LUNAR TIDE = $6^d\ 5^h$.

No.	Difference.	No.	Difference.	No.	Difference.	No.	Difference.
	Days.		Days.		Days.		Days.
1	-0·65	10	+0·15	18	-0·35	26	+0·65
2	-1·25	11	+1·15	19	+0·75	27	-1·35
3	-3·65	12	+1·05	20	-1·45	28	-0·05
4	-2·35	13	+1·65	21	+0·60	29	-1·05
5	+1·20	14	-1·20	22	-0·25	30	-0·35
6	0·00	15	+0·65	23	+0·15	31	+0·55
7	+4·05	16	-1·10	24	-2·00	32	-0·60
8	+0·30	17	+1·75	25	+0·25	33	+1·90
9	+0·95						

Mean Difference = + 0·003 Days.

DONAGHADEE.—TABLE F.

DIFFERENCE *of Observed and Calculated Times of Vanishing of Diurnal Tide at Donaghadee, at Low Water, expressed in Lunar Days.*

AGE OF LUNAR TIDE = $5^d\ 2^h$.

No.	Difference.	No.	Difference.	No.	Difference.	No.	Difference.
	Days.		Days.		Days.		Days.
1	+0·10	10	+1·10	18	+0·20	26	+1·75
2	+1·00	11	-1·45	19	-0·55	27	+0·75
3	-0·45	12	-1·10	20	+1·15	28	-1·05
4	+1·00	13	-0·95	21	-0·65	29	+1·60
5	+0·20	14	-0·05	22	+1·45	30	+1·30
6	-2·80	15	-0·40	23	-0·35	31	+0·75
7	-0.65	16	-0·90	24	+0·85	32	-1·35
8	+1.30	17	-0·10	25	-0·20	33	-2·00
9	+0·85						

Mean Difference = + 0·010 Days.

The agreement of the Observed and Calculated Diurnal Tides, shown in the preceding Tables, is excellent.

SECTION X.—DIURNAL TIDE AT KINGSTOWN.

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1850.		
Dec. 8		
9	−·393	·000
10	−·243	+·218
11	−·443	+·562
12	−·175	+·325
13	−·300	+·750
14	7 A. M. −·762	1 P. M. +·606
15	−·456	+1·293
16	−·181	+1·318
17	−·168	+·418
18	−·250	−·018
19	−·156	−·200
20	·000	+·118
21	12.15 P. M. +·062	6.15 P. M. +·012
22	−·062	+·143
23	−·143	+·087
24	+·131	·000
25	+·012	+·050
26	−·018	−·400
27	+·300	−·743
28	7.30 P. M. +·331	−·443
29	+·243	+·050
30, 31	+·262	+·312
1851.		
Jan. 1	−·031	+·218
2	+·293	+·612
3	−·006	+·218
4	−·450	5.45 A. M. +·218
5	−·425	+·150
6	−·368	+·250
7	−·468	+·200
8	−·431	+·293
9	−·706	+·550
10	−·550	+·718
11	−·525	+·493
12	−·343	+·468
13	7.30 A. M. −·043	1 P. M. +·843
14	−·118	+·381
15	+·468	−·100
16	+·018	−·281
17	+·218	−·475
18	+·250	−·487
19	+·368	−·300
1851.		
Jan. 20	1 P. M. +·193	6.45 P. M. −·050
21	+·275	−·425
22	+·625	−·550
23	+·568	−·431
24	+·131	−·506
25	+·250	−·150
26	+·412	−·393
27	8.15 P. M. +·112	−2·000
28	−·200	−1·300
29	−·281	−·362
30, 31	−·231	+·250
Feb. 1	−·037	−·125
2	+·025	−·018
3	−·393	6 A. M. +·443
4	−·656	+·262
5	−·731	+·512
6	−·856	+·493
7	−·787	+·331
8	−·475	+·081
9	−·031	+·143
10	−·356	+·093
11	6.30 A. M. −·118	12.30. +·062
12	+·062	+·143
13	+·112	−·212
14	+·075	−·206
15	+·225	−·250
16	+·162	−·068
17	+·468	−·318
18	12.30 P. M. +·612	6.15 P. M. −·231
19	+·493	−·306
20	+·456	−·162
21	+·443	−·112
22	+·275	−·056
23	+·175	·000
24	+·075	+·106
25	8 P. M. −·031	+·087
26	−·106	+·093
27, 28	−·287	+·112
Mar. 1	−·343	+·043
2	−·387	+·093
3	−·437	+·106
4	−·393	−·087
5	−·093	6.15 A. M. +·037
6	−·431	−·012
7	−·343	−·037

DIURNAL TIDE AT KINGSTOWN—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
Mar. 8	−·150	−·156	April 23	−·181	+·443
9	−·300	−·618	24	−·112	+·593
10	−·006	−·037	25	8 P. M. −·081	+·575
11	+·137	−·225	26	−·050	+·450
12	6 A. M. +·062	11.45 A. M. −·243	27	−·025	+·175
13	−·087	−·131	28	−·062	+·025
14	+·056	−·287	29, 30	−·037	−·006
15	+·062	−·400	May 1	−·143	+·006
16	+·193	−·531	2	−·125	−·037
17	+·287	−·456	3	−·025	6 A. M. −·100
18	+·287	−·318	4	−·056	−·093
19	12.15 P. M. +·256	6.15 P. M. −·250	5	−·037	+·081
20	+·656	·000	6	+·056	−·162
21	+·450	+·006	7	+·143	−·456
22	+·275	−·056	8	+·306	−·312
23	+·306	·000	9	+·118	−·525
24	+·181	+·168	10	6,15 A. M. +·143	12.30 P. M. −·393
25	+·106	−·156	11	+·112	−·112
26	7.15 P. M. ·000	+·112	12	−·018	−·362
27	+·031	+·262	13	+·062	−·437
28	−·100	+·212	14	+·137	−·337
29	−·256	+·218	15	+·087	−·168
30, 31	−·300	+·075	16	+·068	+·012
April 1	−·018	+·156	17	12.30 P. M. +·137	6.15 P. M. −·006
2	−·100	+·275	18	+·168	−·062
3	−·131	6 A. M. +·212	19	−·075	+·250
4	−·181	+·081	20	−·287	+·450
5	−·025	+·006	21	−·500	+·356
6	+·062	−·162	22	−·350	+·443
7	+·031	−·218	23	−·293	+·506
8	+·031	−·225	24	7 P. M. −·150	+·500
9	+·062	−·237	25	−·062	+·412
10	+·050	−·181	26	−·087	+·175
11	7 A. M. −·018	1 P. M. −·381	27	+·012	+·006
12	+·043	−·900	28	−·025	+·037
13	+·025	−·625	29, 30	−·143	+·181
14	+·075	−·581	31	+·031	−·018
15	+·162	−·443	June 1	+·175	−·118
16	+·162	−·437	2	+·150	6.15 A. M. −·093
17	+·131	−·181	3	+·043	+·043
18	12.45 P. M. +·237	6.15 P. M. +·031	4	−·056	−·125
19	+·262	+·243	5	+·331	−·006
20	+·018	+·287	6	+·168	−·550
21	−·337	+·350	7	−·143	−·812
22	−·312	+·387	8	−·318	−·581

DIURNAL TIDE AT KINGSTOWN—*continued.*

Date.	Diurnal Tide at High Water.		Diurnal Tide at Low Water.		Date.	Diurnal Tide at High Water.		Diurnal Tide at Low Water.	
1851.					1851.				
June 9	7.15 A. M.	−·312	1 P. M.	−·400	July 25		+·087		+·243
10		+·087		−·350	26		+·162		−·056
11		+·068		−·275	27		+·075		−·018
12		−·018		+·106	28, 29		−·043		+·100
13		+·256		−·025	30		+·206	5.30 A. M.	−·350
14		−·025		+·112	31		+·218		−·212
15		−·218		+·318	Aug. 1		+·187		−·375
16	12.45 P. M.	−·256	6.30 P. M.	+·300	2		+·400		−·550
17		−·306		+·375	3		+·537		−·456
18		−·237		+·437	4		+·275		−·125
19		−·387		+·400	5		+·087		−·125
20		−·512		+·481	6	6.15 A. M.	+·112	12.30 P. M.	−·331
21		−·387		+·562	7		+·006		−·118
22		−·268		+·350	8		−·112		+·056
23	7 P. M.	−·125		+·100	9		−·162		+·118
24		−·043		−·106	10		+·025		+·050
25		+·062		+·037	11		−·231		+·150
26		+·181		+·112	12		·000		+·243
27		+·212		+·075	13	12.15 P. M.	−·350	5.45 P. M.	+·081
28		+·131		−·025	14		−·225		+·168
29, 30		+·093		−·150	15		·000		−·031
July 1		+·193	5.45 A. M.	−·318	16		−·131		−·250
2		+·312		−·387	17		−·343		+·068
3		+·300		−·506	18		−·400		+·131
4		+·331		−·568	19		−·200		+·312
5		+·337		−·612	20		−·225		+·418
6		+·025		−·281	21	6.15 P. M.	+·143		+·156
7		+·050		−·256	22		+·393		+·025
8	6.45 A. M.	+·212	12.45 P. M.	−·456	23		+·100		−·256
9		+·006		−·250	24		−·175		−·425
10		+·037		−·118	25		−·062		+·181
11		−·068		+·037	26, 27		+·187		−·187
12		−·275		+·225	28		+·456	5.15 A. M.	−·568
13		−·456		+·312	29		+·406		−·425
14		−·093		+·468	30		+·393		−·381
15	12.30 P. M.	−·025	6 P. M.	+·362	31		+·087		−·256
16		−·031		+·225	Sept. 1		+·143		−·100
17		−·056		−·031	2		+·262		+·025
18		−·200		−·093	3		+·100		+·075
19		+·050		+·137	4	6.30 A. M.	+·075	11.45 A. M.	−·006
20		+·375		+·118	5		−·143		+·018
21		−·212		+·243	6		−·206		−·006
22		−·112		−·068	7		−·143		+·043
23	7 P. M.	−·300		−·112	8		−·137		+·300
24		−·256		+·112	9		−·300		+·293

DIURNAL TIDE AT KINGSTOWN—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
Sept. 10	−·150	−·018	Oct. 27	+·143	5.30 A. M. +·106
11	−·100	+·193	28	−·093	−·106
12	12.15 P. M. −·356	5.45 P. M. +·112	29	−·281	−·006
13	−·162	+·168	30	−·387	+·112
14	−·406	+·137	31	+·144	+·387
15	−·312	+·131	Nov. 1	−·206	+·262
16	−·181	+·093	2	+·275	+·181
17	−·131	−·025	3	7.45 A. M. −·275	1.15 P. M. +·462
18	−·025	−·012	4	−·075	+·331
19	+·043	−·106	5	−·206	+·362
20	6.45 P. M. +·150	−·262	6	−·193	−·012
21	+·162	−·418	7	−·037	−·262
22	+·256	−·487	8	−·293	+·118
23	+·250	−·306	9	−·493	+·212
24	+·325	−·143	10	11.45 A. M. −·087	5.15 A. M. +·206
25, 26	−·175	−·393	11	·	·
27	−·062	5.45 A. M. −·343	12	·	·
28	+·256	−·306	13	·	·
29	+·206	−·137	14	·	·
30	+·231	−·068	15	·	·
Oct. 1	+·125	+·050	16	·	·
2	+·243	+·087	17	·	·
3	−·425	+·337	18	·	·
4	7 A. M. −·100	12.45 P. M. +·443	19	·	·
5	−·250	+·075	20	·	·
6	−·175	+·181	21	·	·
7	+·087	·000	22	·	·
8	−·512	+·200	23, 24	·	·
9	−·443	+·331	25	·	5.45 A. M. ·
10	−·293	+·106	26	·	−·081
11	11.45 A. M. −·325	5 P. M. +·343	27	−·012	+·050
12	−·506	−·006	28	−·450	+·431
13	−·006	−·162	29	−·450	+·437
14	−·131	−·362	30	−·512	+·625
15	−·087	−·425	Dec. 1	−·418	+·331
16	+·018	−·156	2	7 A. M. −·187	12.15 P. M. +·343
17	−·100	−·175	3	−·050	+·656
18	+·181	−·237	4	−·112	+·518
19	+·400	−·575	5	−·012	+·300
20	7.45 P. M. +·137	−·481	6	+·031	+·237
21	−·193	−·493	7	−·162	−·006
22	+·100	−·587	8	+·243	+·250
23	+·106	−·425	9	+·493	+·537
24	+·193	−·368	10	Noon. +·218	5.45 A. M. +·106
25, 26	+·243	−·081	11	+·031	−·306

DIURNAL TIDE AT KINGSTOWN—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
Dec. 12	+·243	−·281	December		
13	+·312	−·406	22, 23	−·093	+·181
14	+·431	−·543	24	·	5.15 A.M. ·
15	+·225	−·337	25	·	·
16	−·050	−·656	26	·	·
17	6·30 P.M. +·168	−·900	27	·	·
18	+·318	−·806	28	·	·
19	+·218	−·412	29	·	·
20	+·200	−·175	30	·	·
21	+·143	+·075	31	·	·

The Solar and Lunar Diurnal Tides at Kingstown were obtained separately, as before, from the preceding Tables, and found to give the following results :—

I.—*Diurnal Tide at High Water.*

1. Maximum value of Lunar Tide for Positive Heights = 0·285 ft.
2. Maximum value of Lunar Tide for Negative Heights = 0·34 ft.
3. Maximum value of Solar Tide = 0·255 ft.
4. Diurnal Solitidal Interval = $10^h\ 26^m$.
5. Age of Lunar Tide = $6^d\ 17^h$.

II.—*Diurnal Tide at Low Water.*

1. Maximum value of Lunar Tide for Positive Heights = 0·27 ft.
2. Maximum value of Lunar Tide for Negative Heights = 0·40 ft.
3. Maximum value of Solar Tide = 0·255 ft.
4. Diurnal Solitidal Interval = $10^h\ 26^m$.
5. Age of Lunar Tide = $4^d\ 11^h$.

Adding the first two of each of the preceding, we find,

Range of Lunar Tide at High Water = 0·625 ft.
Range of Lunar Tide at Low Water = 0·670 ft.

Hence, by equation (3),

$$\cot(m - i_m) = \frac{0{\cdot}625}{0{\cdot}670} = \cot(47°),$$

or, converting the arc into time,

$$m - i_m = 3^h\ 14^m;$$

but since m is the Moon's Hour-angle, in Kingstown time, at High Water, and is equal to $10^h\ 53^m$; we find,

$$i_m = 7^h\ 39^m.$$

By equation (4), we have

$$\text{Maximum value of } 2M \sin 2\mu = \sqrt{(0{\cdot}625)^2 + (0{\cdot}670)^2} = 0{\cdot}916 \text{ ft.}$$

From which we obtain

$$M = 0{\cdot}690 \text{ ft.};$$

also, since the maximum value of the Solar Tide is 0·255 ft., we find,

$$\text{Max. value of } 2S \sin 2\sigma = 0{\cdot}510 \text{ ft.},$$

and,

$$S = 0{\cdot}348 \text{ ft.}$$

Combining these results, we obtain as Tide Constants at Kingstown:—

1. Lunitidal Interval = $7^h\ 39^m$.
2. Solitidal Interval = $10^h\ 26^m$.
3. Age of Lunar Tide at High Water = $6^d\ 17^h$.
   Age of Lunar Tide at Low Water = $4^d\ 11^h$.
4. Lunar Coefficient = 0·690 ft.
5. Solar Coefficient = 0·348 ft.
6. Ratio of Solar to Lunar Coefficient,

$$\text{or } \frac{S}{M} = 0{\cdot}504.$$

The Theoretical Tides were carefully constructed with the foregoing Constants, and compared with the observed Tides. The results of the comparison are contained in the following Tables:—

KINGSTOWN.—TABLE A.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDES *at Kingstown at High Water; Positive Heights for Thirteen and one-half Lunations, commencing* 1850, *December* 19^d 3^h, *and ending* 1851, *December* 22^d 14^h 30^m.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·28	0·29	−0·01	8	0·33	0·32	+0·01
2	0·32	0·38	−0·06	9	0·36	0·41	−0·05
3	0·50	0·36	+0·14	10	0·37	0.39	−0·02
4	0·35	0·29	+0·06	11	0·27	0·29	−0·02
5	0·16	0·19	−0·03	12	0·20	0·19	+0·01
6	0·17	0·16	+0·01	13			
7	0·18	0·25	−0·07	14	0·28	0·31	−0·03

Mean Difference = − 0·005 ft.

KINGSTOWN.—TABLE B.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDES *at Kingstown at High Water; Negative Heights for Thirteen Lunations, commencing* 1850, *December* 19^d 3^h, *and ending* 1851, *December* 9^d 8^h 30^m.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·53	0·40	+0·13	7	0·42	0·39	+0·03
2	0·70	0·44	+0·26	8	0·26	0·46	−0·20
3	0·40	0·40	0·00	9	0·26	0·44	−0·18
4	0·24	0·28	−0·04	10	0·35	0·41	−0·06
5	0·22	0·22	0·00	11	0·33	0·29	+0·04
6	0·36	0·30	+0·06	12	0·22	0·26	−0·04

Mean Difference = 0·000 ft.

KINGSTOWN.—TABLE C.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDES *at Kingstown at Low Water; Positive Heights for Thirteen Lunations, commencing* 1850, *December* 30^d 1^h 3^m, *and ending* 1851, *December* 20^d 14^h 41^m.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·65	0·52	+0·13	8	0·36	0·39	−0·03
2	0·41	0·42	−0·01	9	0·27	0·29	−0·02
3	0·11	0·27	−0·16	10	0·20	0·25	−0·05
4	0·25	0·31	−0·06	11	0·28	0·30	−0·02
5	0·55	0·39	+0·16	12	0·39	0·40	−0·01
6	0·50	0·47	+0·03	13	0·52	0·51	+0·01
7	0·50	0·52	−0·02				

Mean Difference = − 0·004 ft.

KINGSTOWN.—TABLE D.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDES *at Kingstown at Low Water; Negative Heights for Thirteen Lunations, commencing* 1850, *December* 30^d 1^h 3^m, *and ending* 1851, *December* 20^d 14^h 41^m.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·53	0·56	−0·03	8	0·45	0·45	0·00
2	0·28	0·43	−0·15	9	0·45	0·43	+0·02
3	0·42	0·39	+0·03	10	0·42	0·40	+0·02
4	0·54	0·44	+0·10	11	0·53	0·47	+0·06
5	0·45	0·53	−0·08	12			
6	0·48	0·58	−0·10	13	0·70	0·63	+0·07
7	0·56	0·57	−0·01				

Mean Difference = − 0·006 ft.

KINGSTOWN.—TABLE E.

DIFFERENCE *of Observed and Calculated Times of Vanishing of Diurnal Tide at Kingstown, at High Water, expressed in Lunar Days.*

AGE OF LUNAR TIDE = 6^d 17^h.

No.	Difference.	No.	Difference.	No.	Difference.	No.	Difference.
	Days.		Days.		Days.		Days.
1	+2·7	8	−2·8	15	−0·5	21	−0·5
2	+0·7	9	−0·5	16	+1·0	22	+0·7
3	+0·7	10	+0·7	17	−0·5	23	−1·8
4	+0·6	11	+2·2	18	−0·5	24	−0·5
5	+0·5	12	0·0	19	−0·3	25	−1·5
6	−0·5	13	+0·5	20	−1·0	26	+0·3
7	+2·0	14	−1·7				

Mean Difference = + 0·000 Days.

KINGSTOWN.—TABLE F.

DIFFERENCE *of Observed and Calculated Times of Vanishing of Diurnal Tide at Kingstown, at Low Water, expressed in Lunar Days.*

AGE OF LUNAR TIDE = $4^d\ 11^h$.

No.	Difference.	No.	Difference.	No.	Difference.	No.	Difference.
	Days.		Days.		Days.		Days.
1	+0·3	8	-1·0	15	+0·5	22	+1·1
2	-2·3	9	-0·7	16	-0·7	23	-0·3
3	+0·1	10	-0·1	17	-0·3	24	+0·4
4	+2·2	11	-1·6	18	-0·1	25	+2·7
5	+0·9	12	+1·2	19	+1·1	26	+2·2
6	-1·7	13	+0·5	20	-0·3	27	-0·3
7	-4·5	14	-0·3	21	+1·1		

Mean Difference = + 0·004 Lunar Days.

SECTION XI.—DIURNAL TIDE AT COURTOWN.

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1850.			1850.		
Nov. 1, 2	+·321	-·068	Nov. 18	-·312	-·093
3	+·406	-·093	19	-·062	-·037
4	+·256	+·125	20	+·400	-·012
5	+·075	-·168	21	+·056	-·181
6	+·143	-·031	22	9 A. M. -·056	5 P. M. +·075
7	-·037	-·068	23	+·012	+·050
8	+·087	-·056	24	+·406	-·112
9	-·143	+·087	25	+·281	+·100
10	-·206	+·156	26	+·300	+·106
11	+·025	-·018	27	+·006	-·125
12	-·062	-·256	28	+·087	-·268
13	+·006	-·375	29	4.15 P. M. +·287	-·100
14	-·012	5.30 A. M. -·325	30	+·300	-·237
15	-·193	-·418	Dec. 1	+·175	-·156
16	-·381	-·193	2	+·100	-·243
17	-·412	-·137	3	·000	-·256

Diurnal Tide at Courtown—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1850.			1851.		
Dec. 4, 5	−·256	·000	Jan. 18	+·350	−·225
6	−·075	4.30 A. M. −·187	19	+·462	−·206
7	−·006	+·012	20	9 A. M. +·168	5.15 P. M. +·075
8	−·156	+·006	21	+·368	−·125
9	−·237	−·018	22	+·643	−·318
10	−·193	−·243	23	+·243	−·068
11	−·118	−·006	24	+·112	−·143
12	−·037	+·393	25	+·181	·
13	−·087	+·231	26	+·175	·
14	+·162	−·075	27	2.45 P. M. ·000	·
15	+·543	+·262	28	+·131	+·175
16	+·418	+·006	29	+·243	+·162
17	+·387	+·350	30	−·231	·000
18	+·312	+·081	31	−·168	−·006
19	+·062	−·225	Feb. 1	−·137	+·137
20	+·031	−·006	2	−·368	+·125
21	8.45 A. M. +·312	4.30 P. M. −·056	3	8.45 P. M. −·400	−·100
22	+·243	−·162	4	−·318	−·412
23	+·350	−·212	5	−·462	−·393
24	+·300	+·100	6	−·487	−·381
25	+·175	+·193	7	−·318	−·387
26	+·081	−·006	8	−·087	−·375
27	−·056	+·043	9, 10	+·037	−·200
28	3.15 P. M. +·406	+·218	11	2 A. M. +·331	11.45 A. M. +·075
29	+·331	−·031	12	+·237	−·131
30	+·193	+·062	13	+·031	−·012
31	+·062	+·081	14	+·056	+·100
			15	+·087	+·137
1851.			16	+·187	+·193
Jan. 1	+·150	−·162	17	+·225	+·168
2	+·156	+·087	18	8.45 A. M. +·268	4.30 P. M. +·062
3	−·287	+·087	19	+·318	−·031
4	9 P. M. −·275	−·043	20	+·343	+·018
5	−·143	+ 093	21	+·218	−·118
6	−·206	−·093	22	+·112	−·031
7	−·125	−·237	23	−·168	−·037
8	−·193	−·337	24	−·150	+·068
9	−·206	−·131	25	4.45 P. M. −·150	9.30 P. M. +·018
10	−·175	+·212	26	−·150	−·025
11, 12	−·125	+·306	27	−·175	−·018
13	−·212	11 A. M. +·506	28	−·037	+·050
14	−·212	+·331	Mar. 1	−·243	−·037
15	+·381	−·062	2	−·300	−·062
16	+·037	+·106	3	−·262	−·056
17	+·250	−·018	4	−·244	+·056

DIURNAL TIDE AT COURTOWN—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
Mar. 5	9.45 P. M. −·093	−·212	April 21	−·256	+·100
6	−·143	−·093	22	−·006	+·200
7	+·018	−·087	23	+·168	+·256
8	−·168	−·137	24	+·112	+·343
9	−·112	−·250	25	6 P. M. −·450	+·293
10, 11	−·043	−·143	26	−·187	−·093
12	7.15 A. M. +·056	10.45 A. M. +·056	27	+·068	−·081
13	+·006	−·037	28	+·081	−·131
14	+·025	+·243	29	−·143	−·131
15	+·187	+·287	30	−·137	+·081
16	+·243	+·250	May 1	−·087	+·081
17	+·425	+·243	2	−·031	−·056
18	+·300	+·137	3	9.30 P. M. +·056	−·087
19	8.30 A. M. +·300	4.15 P. M. +·256	4	+·137	−·137
20	+·425	+·275	5	+·231	−·131
21	+·175	+·187	6	+·268	−·112
22	+·175	+·087	7	+·225	−·031
23	+·243	−·150	8, 9	−·187	−·237
24	+·156	−·162	10	0.45 A. M. −·050	11.15 A. M. −·493
25	+·162	−·231	11	+·043	−·487
26	9 P. M. −·081	−·225	12	+·312	−·337
27	+·031	−·187	13	+·293	−·231
28	−·150	−·237	14	+·225	−·150
29	−·050	−·212	15	+·162	−·025
30	−·200	−·162	16	+·100	+·081
31	−·125	−·043	17	8.45 A. M. −·025	4.30 P. M. +·156
April 1	−·143	−·150	18	−·062	+·193
2	−·250	−·093	19	−·112	+·150
3	9.10 P. M. −·237	+·025	20	−·181	−·125
4	−·162	+·150	21	−·206	−·318
5	+·050	+·150	22	·000	−·300
6	+·118	+·093	23	+·056	−·150
7	+·050	−·068	24	7.45 P. M. +·181	+·343
8	−·087	−·150	25	−·181	+·162
9, 10	−·081	−·225	26	−·037	+·087
11	8.15 A. M. −·068	12.15 P. M. −·237	27	−·068	+·093
12	−·000	−·312	28	−·093	+·137
13	+·293	−·387	29	−·068	+·068
14	+·356	−·312	30	−·075	−·018
15	+·356	−·393	31	+·068	−·043
16	+·268	−·393	June 1	+·131	−·087
17	+·106	−·018	2	9.30 P. M. +·168	−·256
18	9 A. M. +·012	5 P. M. +·250	3	+·187	−·462
19	−·112	+·200	4	+·350	−·281
20	−·218	+·131	5	+·231	−·050

DIURNAL TIDE AT COURTOWN—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
June 6	−·218	−·081	July 23	9 P. M. −·006	+·181
7, 8	+·237	+·137	24	−·056	+·112
9	8.45 A. M. +·187	Noon. −·050	25	−·137	+·006
10	+·331	−·156	26	−·031	−·100
11	+·237	−·087	27	+·075	−·156
12	+·018	+·012	28	+·143	−·212
13	−·137	+·012	29	+·381	−·362
14	−·143	+·137	30	9 P. M. +·450	−·075
15	−·362	+·206	31	+·462	−·025
16	8.45 A. M. −·393	5 P. M. +·218	Aug. 1	+·568	−·218
17	−·350	+·106	2	+·525	−·143
18	−·406	−·018	3	+·456	−·075
19	−·293	−·131	4, 5	+·225	−·112
20	−·156	−·312	6	7 A. M. +·100	12.30 P. M. −·150
21	−·037	−·375	7	+·062	+·012
22	−·018	−·175	8	−·075	−·018
23	8.15 P. M. +·125	+·281	9	−·200	−·056
24	+·112	+·250	10	−·275	−·012
25	−·112	+·181	11	−·287	+·006
26	−·168	+·081	12	−·343	+·143
27	−·037	+·087	13	8 A. M. −·337	4 P. M. +·106
28	+·025	−·018	14	−·268	+·075
29	+·100	−·106	15	−·331	+·206
30	+·281	−·206	16	−·275	+·168
July 1	9.35 P. M. +·425	−·206	17	−·181	−·068
2	+·425	−·281	18	−·062	−·212
3	+·275	−·075	19	·000	+·112
4	+·318	−·050	20	+·006	+·050
5	+·581	−·275	21	7.45 P. M. +·225	−·062
6, 7	+·393	−·193	22	+·337	−·056
8	7 A. M. +·150	11 A. M. −·237	23	+·131	+·043
9	+·181	−·150	24	+·375	−·068
10	+·125	+·068	25	+·281	−·175
11	−·043	+·187	26	+·318	−·262
12	−·143	+·162	27	+·556	−·343
13	−·393	+·181	28	9 P. M. +·568	−·143
14	−·400	+·293	29	+·368	+·118
15	8.30 A. M. −·475	4.15 P. M. +·343	30	+·475	+·131
16	−·506	+·100	31	+·400	−.037
17	−·506	−·093	Sept. 1	+·350	−·012
18	−·418	−·243	2, 3	+·218	+·075
19	−·206	−·400	4	7 A. M. +·118	12.30 P. M. +·168
20	−·200	−·456	5	−·050	+·143
21	−·087	−·343	6	−·162	+·193
22	−·050	+·131	7	−·093	−·231

DIURNAL TIDE AT COURTOWN—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
Sept. 8	+·050	−·143	Oct. 24	+·375	−·087
9	−·368	+·506	25	+·256	+·006
10	−·512	+·137	26	+·231	+·043
11	−·462	+ 012	27	9.30 P. M. +·031	+·006
12	8 A. M. −·381	3.30 P. M. +·068	28	+·093	−·037
13	−·306	+·056	29	+·012	−·200
14	−·237	+·006	30	+·018	−·143
15	−·200	+·006	31	+·112	+·125
16	−·168	−·137	Nov. 1, 2	+·137	+·281
17	−·112	−·187	3	8 A. M. −·106	10.45 A. M. +·312
18	·000	−·043	4	−·106	+·156
19	+·062	+·031	5	−·250	+·143
20	8 P. M. +·037	1.30 A. M. −·168	6	−·287	+·087
21	+·100	−·318	7	−·375	+·125
22	+·337	−·350	8	−·237	+·043
23	+·331	−·318	9	−·225	−·131
24	+·250	+·025	10	7.45 A. M. −·137	3.30 P. M. +·050
25	+·125	−·131	11	−·168	+·312
26	+·425	−·087	12	+·037	−·050
27	9.20 P. M. +·406	+·050	13	+·062	−·100
28	+·062	+·262	14	+·018	·000
29	+·256	−·068	15	+·106	−·056
30	+·112	+·068	16	+·056	+·056
Oct. 1	−·018	+·281	17	+·056	−·168
2, 3	+·093	+·381	18	3.30 P. M. +·400	1.30 A. M. −·425
4	8.30 A. M. +·181	12.45 P. M. +·481	19	+·456	−·375
5	−·262	+·481	20	+·243	−·268
6	−·387	+·237	21	+·212	−·406
7	−·506	+·218	22	+·218	−·193
8	−·575	+·143	23	+·300	+·006
9	−·362	·000	24	−·043	+·062
10	−·281	−·050	25	9.15 P. M. −·062	+·125
11	8 A. M. −·281	3 P. M. +·181	26	+·006	+·206
12	−·418	−·006	27	−·200	−·018
13	−·012	+·006	28	+·037	−·325
14	−·068	−·025	29, 30	−·087	−·125
15	+·275	−·062	Dec. 1	−·100	+·525
16	+·243	+·168	2	8 A. M. +·012	5.30 P. M. +·512
17	+·012	+·131	3	−·037	+·393
18	+·112	−·193	4	−·237	+·068
19	+·225	−·343	5	−·300	−·037
20	3 P. M. +·181	Midnight. −·275	6	−·262	+·081
21	+·331	−·362	7	−·262	+·006
22	+·412	−·337	8	+·225	+·037
23	+·393	−·218	9	+·037	+·187

DIURNAL TIDE AT COURTOWN—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
Dec. 10	8.30 A. M. +·037	4.15 P. M. +·062	Dec. 21	–·012	+·143
11	+·081	–·093	22	–·175	+·062
12	+·300	–·118	23	–·287	–·006
13	+·318	–·231	24	9 P. M. –·262	+·106
14	+·275	–·237	25	–·331	–·162
15	+·281	–·375	26	–·237	–·031
16	+·287	–·537	27	–·218	–·143
17	2.45 P. M. +·337	11 P. M. –·450	28	–·181	–·318
18	+·443	–·331	29	–·068	–·400
19	+·231	–·125	30	–·031	
20	+·056	+·037	31		

On proceeding to calculate, from the preceding Table, the Diurnal Tide Constants at Courtown, I found that it was impossible to construct satisfactorily the Diurnal Tide at Low Water. The Equinoctial Lunar Tide at Low Water was ± 0·25 ft.; and this value was the same for the Spring and Autumnal Equinoctial Tides; but on constructing the Tides from the Spring Equinoctial Tide, I could not reconcile it with the Autumnal Tide, and *vicê versa.* I, therefore, abandoned the attempt to reconcile Theory and Observation with respect to the Tide at Low Water at this Station, and have only used the Lunar Equinoctial tide in height, which was found to be accurately the same in amount at both Equinoxes:—

I.—*Diurnal Tide at High Water.*

1. Maximum value of Lunar Tide for Positive Heights = 0·40 ft.
2. Maximum value of Lunar Tide for Negative Heights = 0·40 ft.
3. Maximum value of Solar Tide = 0·30 ft.
4. Diurnal Solitidal Interval = 5^h 1^m.
5. Age of Lunar Tide = 6^d 22^h.

II.—*Diurnal Tide at Low Water.*

1. Maximum value of Lunar Tide for Positive Heights = 0·25 ft.
2. Maximum value of Lunar Tide for Negative Heights = 0·25 ft.
3. Maximum value of Solar Tide = 0·30 ft.?
4. Diurnal Solitidal Interval = 5^h 1^m?
5. Age of Lunar Tide = 3^d 12^h?

Adding together the first two of each of the preceding results, we find

Range of Lunar Tide at High Water = 0·80 ft.
Range of Lunar Tide at Low Water = 0·50 ft.

Hence, by equation (3),

$$\cot(m - i_m) = \frac{0{\cdot}80}{0{\cdot}50} = \cot(32°),$$

or, converting the arc into time,

$$m - i_m = 2^h\ 12^m;$$

but since m, the Moon's Hour-angle at High Water, expressed in Courtown time, is $7^h\ 40^m$, we obtain

$$i_m = 5^h\ 28^m.$$

By equation (4), we have

$$\text{Max. value of } 2M \sin 2\mu = \sqrt{(0{\cdot}80)^2 + (0{\cdot}50)^2} = 0{\cdot}943\text{ft.}$$

From which we find

$$M = 0{\cdot}719 \text{ ft.}$$

Also, since the mean value of the Solar Tide is 0·30 ft., we have

$$\text{Max. value of } 2S \sin 2\sigma = 0{\cdot}600 \text{ ft.},$$

and, therefore,

$$S = 0{\cdot}410 \text{ ft.}$$

Combining the foregoing results, we obtain for the Tide Constants at Courtown:—

1. Lunitidal Interval = $5^h\ 28^m$.
2. Solitidal Interval = $5^h\ 1^m$.
3. Age of Lunar Tide at High Water = $6^d\ 22^h$.
   Age of Lunar Tide at Low Water = $3^d\ 12^h$?
4. Lunar Coefficient = 0·719 ft.
5. Solar Coefficient = 0·410 ft.
6. Ratio of Solar to Lunar Coefficient,—

$$\text{or } \frac{S}{M} = 0{\cdot}570.$$

The Theoretical Tides at High Water were constructed with the foregoing Constants, and compared with the Observed Tides. The results of this comparison are contained in the following Tables:—

Courtown.—Table A.

Comparison of the Observed and Calculated Diurnal Tides *at Courtown at High Water; Positive Heights for Fifteen and a half Lunations, commencing* 1850, *November* $7^d\ 9^h\ 48^m$, *and ending* 1851, *December* $31^d\ 14^h\ 36^m$.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·30	0·25	+0·05	9	0·43	0·37	+0·06
2	0·33	0·35	−0·02	10	0·52	0·50	+0·02
3	0·40	0·45	−0·05	11	0·47	0·50	−0·03
4	0·31	0·42	−0·11	12	0·34	0·38	−0·04
5	0·35	0·38	−0·03	13	0·40	0·27	+0·13
6	0·31	0·32	−0·01	14	0·27	0·23	+0·04
7	0·22	0·20	+0·02	15	0·35	0·35	0·00
8	0·27	0·29	−0·02				
Mean Difference = + 0·001 ft.							

Courtown.—Table B.

Comparison of the Observed and Calculated Diurnal Tides *at Courtown at High Water; Negative Heights for Fifteen and a half Lunations, commencing* 1850, *November* $7^d\ 9^h\ 48^m$, *and ending* 1851, *December* $31^d\ 14^h\ 36^m$.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·30	0·20	+0·10	9	0·38	0·25	+0·13
2	0·17	0·22	−0·05	10	0·47	0·39	+0·08
3	0·20	0·28	−0·08	11	0·34	0·45	−0·11
4	0·45	0·45	0·00	12	0·46	0·48	−0·02
5	0·27	0·42	−0·15	13	0·50	0·33	+0·17
6	0·23	0·32	−0·09	14	0·30	0·25	+0·05
7	0·17	0·24	−0·07	15	0·25	0·25	0·00
8	0·20	0·17	+0·03	16	0·30	0·33	−0·03
Mean Difference = − 0·002 ft.							

Courtown.—Table E.

Difference *of Observed and Calculated Times of Vanishing of Diurnal Tide at Courtown at High Water, expressed in Lunar Days.*

Age of Lunar Tide = $6^d\ 22^h$.

No.	Difference.	No.	Difference.	No.	Difference.	No.	Difference.
	Days.		Days.		Days.		Days.
1	+0·31	9	−1·99	17	+0·41	25	+0·31
2	+0·81	10	+0·31	18	+2·31	26	−2·44
3	+0·11	11	+0·31	19	+1·56	27	+0·06
4	−1·94	12	+1·56	20	+1·56	28	+0·81
5	+0·81	13	−0·94	21	+0·81	29	+1·31
6	+0·81	14	−5·19	22	−1·69	30	+0·81
7	+1·31	15	−1·79	23	+0·21	31	+0·81
8	−1·44	16	−0·44	24	+0·41		
Mean Difference = − 0·004 Days.							

The agreement between Theory und Observation, shown in the preceding Tables, is very satisfactory, and were it not for the difficulties presented in the Low Water Observations, we would consider the Tides at Courtown well represented by the Theoretical Tides. This discrepancy between Theory and Observation at Courtown is probably connected with the peculiarities of the Courtown Tides, which have been brought to light by the Astronomer Royal, in his discussion of the Semidiurnal Tide at this Station.

SECTION XII.—DIURNAL TIDE AT DUNMORE EAST.

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1850.			1850.		
Nov. 1	+·175	+·034	Dec. 5	−·043	−·262
2	+·128	+·118	6	7 P. M. −·056	−·256
3	−·031	+·381	7	−·081	−·062
4	−·134	−·018	8	+·037	−·062
5	+·081	+·018	9, 10	−·125	−·225
6	−·003	−·065	11	−·193	−·175
7	7.30 P. M. +·103	−·034	12	−·275	−·212
8	−·093	−·081	13	−·162	−·125
9, 10	−·159	−·215	14	−·118	6.45 A. M. −·156
11	−·165	−·231	15	−·306	−·437
12	−·243	−·243	16	−·181	−·306
13	−·181	−·162	17	−·218	−·018
14	−·156	6.45 A. M. −·106	18	−·106	−·343
15	−·290	−·071	19	+·050	−·356
16	−·237	−·046	20	+·125	+·068
17	−·303	−·112	21	6.30 A. M. +·193	12.30 P. M. +·537
18	−·090	−·268	22	+·018	+·700
19	+·168	−·337	23	+·081	+·206
20	−·362	−·103	24	+·168	+·062
21	−·246	+·053	25	+·187	+·031
22	7 A. M. −·050	1.15 P. M. +·031	26	+·456	+·456
23	+·168	−·084	27	+·331	+·181
24	+·434	+·012	28	1 P. M. +·275	7.30 P. M. +·150
25	+·025	+·112	29	+·518	+·175
26	+·246	+·084	30	+·106	−·031
27	+·153	·000	31	−·162	+·093
28	−·262	−·018			
29	1.15 P. M. +·062	7.45 A. M. +·050	1851.		
30	+·200	−·037	Jan. 1	−·193	+·112
Dec. 1	+·306	−·078	2	−·325	−·081
2	+·087	−·100	3	−·100	−·187
3	·000	−·043	4	7.15 P. M. +·487	−·225
4	−·156	−·087	5	−·068	+ 200

DIURNAL TIDE AT DUNMORE EAST—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.		
Jan. 6	−·093	−·025
7	+·006	−·100
8	−·237	−·262
9	−·406	+·131
10	−·200	+·112
11, 12	−·106	−·025
13	−·356	7 A. M. −·062
14	−·012	−·218
15	+·562	−·012
16	−·062	+·393
17	+·118	+·212
18	+·193	+·031
19	+·218	+·206
20	7 A. M. −·137	1.15 P. M. +·368
21	+·081	+·112
22	+·250	−·037
23	+·162	+·018
24	+·212	+·162
25	+·168	+·206
26	+·043	−·018
27	1 P. M. −·031	7.30 P. M. +·068
28	+·200	−·025
29	+·300	−·212
30	+·093	−·062
31	+·143	+·100
Feb. 1	−·056	+·062
2	−·050	+·056
3	7 P. M. −·137	−·212
4	−·056	−·262
5	+·156	−·150
6	−·043	+·418
7	−·012	−·137
8	−·025	−·193
9, 10	−·100	−·112
11	−·031	6.30 A. M. −·025
12	−·056	+·037
13	−·012	·000
14	+·075	−·043
15	+·131	+·087
16	+·106	+·043
17	+·168	+·131
18	6.45 A. M. +·118	1 P. M. +·187
19	+·068	+·212
20	+·100	+·006
21	+·106	−·268
1851.		
Feb. 22	−·062	+·106
23	−·106	+·043
24	−·043	−·100
25	12.45 P. M. −·112	7.15 P. M. −·018
26	−·037	+·037
27	−·125	−·056
28	−·081	−·100
Mar. 1	−·056	−·200
2	−·075	−·212
3	+·200	−·043
4	+·231	−·012
5	7.30 P. M. −·106	−·012
6	−·087	+·181
7	−·006	+·093
8	+·012	−·131
9	−·062	−·075
10 11	+·031	−·131
12	+·112	~~6.15 A. M.~~ +·025
13	−·012	−·356
14	−·075	−·325
15	+·025	−·125
16	−·162	−·050
17	−·225	−·006
18	−·368	−·106
19	6,45 A. M. −·068	1 P. M. +·275
20	+·087	+·400
21	−·031	+·306
22	+·243	+·212
23	+·143	+·143
24	−·081	+·056
25	−·081	−·106
26	12.15 P. M. −·150	6.45 P. M. −·106
27	−·168	−·250
28	−·050	−·087
29	−·150	−·056
30	−·062	−·075
31	−·012	−·081
April 1	−·131	−·056
2	−·256	−·362
3	7 P. M. −·206	−·443
4	−·025	−·075
5	+·081	−·037
6	+·068	−·075
7	+·125	−·050
8	+·150	−·075

Diurnal Tide at Dunmore East—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
April 9, 10	+·137	−·037	May 26	−·206	−·062
11	+·150	7 A. M. +·050	27	−·056	+·062
12	+·193	−·037	28	+·012	+·043
13	+·181	−·068	29	+·150	+·137
14	+·112	−·043	30	+·068	+·018
15	+.018	+·012	31	+·118	+·018
16	+·050	−·037	June 1	+·168	−·043
17	+·031	−·018	2	7.15 A. M. +·162	−·050
18	7 A. M. +·025	1 P. M. +·087	3	+·268	−·075
19	−·006	+·087	4	+·275	+·056
20	−·168	+·062	5	+·268	+·068
21	−·206	−·075	6	+·375	+·031
22	−·237	−·012	7, 8	+·275	+·043
23	−·250	−·087	9	+·118	7.30 A. M. −·106
24	−·137	−·143	10	−·025	+·043
25	12.45 P. M. −·256	7 P. M. −·068	11	+·018	−·006
26	−·193	−·068	12	+·006	−·050
27	−·112	−·050	13	−·075	−·100
28	−·006	−·031	14	−·143	−·018
29	+·018	−·056	15	−·237	−·100
30	+·025	−·056	16	7 A. M. −·287	1 P. M. −·075
May 1	+·012	−·062	17	−·306	−·100
2	+·018	−·037	18	−·243	−·050
3	7.15 P. M. +·093	+·031	19	−·206	−·043
4	+·125	+·043	20	−·181	−·125
5	+·187	+·006	21	−·243	−·081
6	+·150	·000	22	−·287	−·093
7	+·093	+·150	23	Noon. −·281	6.30 P. M. −·025
8, 9	+·187	+·106	24	−·243	+·106
10	+·362	6.30 A. M. +·006	25	−·237	−·037
11	+·212	−·012	26	−·137	+·006
12	−·031	+·162	27	+·056	+·037
13	+·100	+·068	28	+·068	−·156
14	+·075	+·037	29	+·100	−·168
15	+·075	+·006	30	+·187	+·037
16	+·037	+·043	July 1	7.15 P. M. +·225	+·037
17	6.45 A. M. −·112	12.30 P. M. +·068	2	+·268	+·050
18	−·106	+·050	3	+·275	+·081
19	−·175	+·043	4	+·237	+·068
20	−·287	−·081	5	+·218	+·056
21	−·256	−·150	6, 7	+·100	+·043
22	−·231	−·112	8	−·012	6.30 A. M. +·018
23	−·193	−·131	9	+·100	+·006
24	11.30 A. M. −·293	6.30 P. M. −·150	10	−·025	+·018
25	−·306	−·106	11	−·112	−·018

DIURNAL TIDE AT DUNMORE EAST—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
July 12	−·162	−·137	Aug. 27	+·331	+·006
13	−·312	−·125	28	6.30 P. M. +·431	+·112
14	−·150	+·050	29	+·218	+·143
15	6.30 A. M. −·225	1 P. M. +·100	30	+·218	+·206
16	−·406	−·106	31	+·118	+·156
17	−·218	−·100	Sept. 1	+·106	+·093
18	−·187	−·118	2, 3	+·031	+·043
19	−·112	−·212	4	−·056	6 A. M. −·006
20	−·181	−·237	5	−·043	−·037
21	−·150	−·106	6	−·175	−·050
22	−·162	−·068	7	−·312	−·106
23	Noon. −·143	6.30 P. M. −·062	8	−·300	−·075
24	−·250	−·112	9	−·225	−·118
25	−·112	−·093	10	−·287	+·025
26	+·025	−·050	11	−·256	−·168
27	+·050	−·031	12	6.15 A. M. −·281	12.30 P. M. −·150
28	+·118	−·018	13	−·241	−·118
29	+·312	+·043	14	−·175	−·118
30	6.30 P. M. +·268	+·056	15	−·081	−·093
31	+·250	+·056	16	−·087	−·200
Aug. 1	+·212	+·137	17	−·037	−·162
2	+·225	+·156	18	−·100	−·087
3	+·262	+·106	19	+·100	−·018
4, 5	+·156	+·106	20	Noon. +·018	6.15 P. M. +·050
6	+·025	6 A. M. +·087	21	+·143	+·012
7	−·087	+·012	22	+·112	−·031
8	−·131	−·018	23	+·025	+·037
9	−·218	−·093	24	+·112	+·118
10	−·118	−·118	25	·000	·000
11	−·037	−·018	26	+·081	+·037
12	−·187	−·043	27	6.45 P. M. +·125	+·162
13	6.15 A. M. −·162	12.30 P. M. −·118	28	−·337	+·262
14	−·131	−·056	29	+·125	+·206
15	−·081	+·112	30	−·031	+·143
16	−·087	−·037	Oct. 1	−·156	−·125
17	−·112	−·056	2, 3	−·200	−·256
18	−·150	+·118	4	−·256	6 A. M. −·056
19	−·031	−·025	5	−·275	−·212
20	−·100	−·068	6	−·325	−·118
21	11.15 A. M. −·150	6 P. M. +·006	7	−·212	−·068
22	−·112	+·043	8	−·056	−·106
23	−·031	+·050	9	−·056	−·075
24	+·168	+·087	10	−·100	−·012
25	+·156	+·106	11	6 A. M. −·150	Noon. −·043
26	+·275	·000	12	−·193	−·218

DIURNAL TIDE AT DUNMORE EAST—*continued.*

Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.	Date.	Diurnal Tide at High Water.	Diurnal Tide at Low Water.
1851.			1851.		
Oct. 13	+·050	-·006	Nov. 22	+·100	-·037
14	-·143	+·100	23	+·043	+·075
15	+·025	+·212	24	-·093	+·012
16	+·043	+·181	25	6.45 A. M. -·281	-·006
17	+·050	+·087	26	-·287	+·012
18	+·087	+·068	27	-·050	+·156
19	+·131	+·087	28	-·212	-·050
20	1 P. M. +·131	7.45 P. M. -·006	29, 30	-·275	- 168
21	+·400	-·050	Dec. 1	-·050	-·250
22	+·287	-·025	2	-·325	6.15 A. M. -·212
23	+·143	+·018	3	-·325	-·118
24	+·106	-·025	4	-·362	-·106
25	+·081	-·012	5	-·237	-·056
26	+·087	+·006	6	-·137	-·012
27	1 P. M. +·018	+·112	7	-·250	+·037
28	+·012	+·043	8	-·093	+·068
29	-·131	-·225	9	+·006	-·318
30	-·168	-·150	10	6.15 A. M. +·143	12.30 P. M. -·018
31	-·243	-·150	11	+·006	+·018
Nov. 1, 2	-·237	+·162	12	+·093	+·056
3	-·337	7 A. M. -·025	13	+·193	-·043
4	-·087	-·006	14	+·206	-·050
5	-·137	-·143	15	+·175	+·062
6	-·237	-·143	16	+·256	+·012
7	-·225	-·100	17	12.45 P. M. +·200	7.30 P. M. +·106
8	-·125	-·031	18	+·268	+·043
9	-·112	-·043	19	+·143	+·031
10	5.30 A. M. -·062	Noon. +·100	20	+·018	+·162
11	-·168	+·050	21	-·100	+·087
12	-·062	+·018	22	·000	-·037
13	+·031	+·025	23	-·131	+·043
14	+·031	-·062	24	6.30 A. M. -·050	-·131
15	+·131	+·018	25	·	·
16	+·106	+·043	26	·	·
17	+·162	+·093	27	·	·
18	1 P. M. +·312	7.30 P. M. +·156	28	·	·
19	+·281	+·112	29	·	·
20	+·175	·000	30	·	·
21	+·143	-·062	31		

Having obtained the preceding values of the Diurnal Tide for each day at Dunmore, I calculated the Constants from them in the usual manner, and found:

I.—*Diurnal Tide at High Water.*

1. Maximum value of Lunar Tide for Positive Heights = 0·22 ft.
2. Maximum value of Lunar Tide for Negative Heights = 0·21 ft.
3. Maximum value of Solar Tide = 0·14 ft.
4. Diurnal Solitidal Interval = $5^h\ 15^m$.
5. Age of Lunar Tide = $5^d\ 19^h$.

II.—*Diurnal Tide at Low Water.*

1. Maximum value of Lunar Tide for Positive Heights = 0·18 ft.
2. Maximum value of Lunar Tide for Negative Heights = 0·19 ft.
3. Maximum value of Solar Tide = 0·14 ft.
4. Diurnal Solitidal Interval = $5^h\ 15^m$.
5. Age of Lunar Tide = $5^d\ 14^h$.

Adding together the first two of each of the preceding, we find,

Range of Lunar Tide at High Water = 0·43 ft.
Range of Lunar Tide at Low Water = 0·37 ft.

Hence, by equation (3),

$$\cot(m - i_m) = \frac{0·43}{0·37} = \cot(40° \; 43'),$$

or, converting the arc into time,

$$m - i_m = 2^h\ 48^m;$$

but since m, the Moon's Hour-angle at High Water, expressed in Dunmore time, is $4^h\ 36^m$; we obtain,

$$i_m = 1^h\ 48^m.$$

By equation (4), we have

$$\text{Maximum value of } 2M \sin 2\mu = \sqrt{(0·43)^2 + (0·37)^2} = 0·567 \text{ ft.}$$

From which we obtain

$$M = 0·441 \text{ ft.};$$

also, since the mean value of the Solar Tide is 0·14 ft., we have, by equation (5),

$$\text{Max. value of } 2S \sin 2\sigma = 0{\cdot}28 \text{ ft.},$$

and,

$$S = 0{\cdot}192 \text{ ft.}$$

Combining the foregoing results, we obtain for the Tide Constants at Dunmore:—

1. Lunitidal Interval = $1^h\ 48^m$.
2. Solitidal Interval = $5^h\ 15^m$.
3. Age of Lunar Tide at High Water = $5^d\ 19^h$.
   Age of Lunar Tide at Low Water = $5^d\ 14^h$.
4. Lunar Coefficient = 0·441 ft.
5. Solar Coefficient = 0·192 ft.
6. Ratio of Solar to Lunar Coefficient,

$$\text{or } \frac{S}{M} = 0{\cdot}436.$$

The Theoretical Tides were constructed with the foregoing Tide Constants, and compared with the observed Tides, with the following results:—

DUNMORE.—TABLE A.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDES *at Dunmore at High Water; Positive Heights for Seventeen Lunations, commencing* 1850, *September* $11^d\ 21^h\ 30^m$, *and ending* 1851, *December* $20^d\ 15^h\ 42^m$.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·17	0·16	+0·01	10	0·31	0·24	+0·07
2	0·30	0·17	+0·13	11	0·28	0·30	−0·02
3	0·20	0·22	−0·02	12	0·30	0·32	−0·02
4	0·35	0·26	+0·09	13	0·34	0·29	+0·05
5	0·26	0·29	−0·03	14	0·12	0·22	−0·10
6	0·13	0·27	−0·14	15	0·25	0·20	+0·05
7	0·17	0·24	−0·07	16	0·28	0·24	+0·04
8	0·17	0·16	+0·01	17	0·21	0·29	−0·08
9	0·19	0·18	+0·01				

Mean Difference = − 0·001 ft.

DUNMORE.—TABLE B.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDES *at Dunmore at High Water; Negative Heights for Seventeen Lunations, commencing* 1850, *September* 11^d 21^h 30^m, *and ending* 1851, *December* 20^d 15^h 42^m.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·21	0·21	0·00	10	0·27	0·24	+0·03
2	0·27	0·16	+0·11	11	0·28	0·28	0·00
3	0·23	0·19	+0·04	12	0·30	0·31	-0·01
4	0·27	0·28	-0·01	13	0·18	0·28	-0·10
5	0·28	0·29	-0·01	14	0·29	0·28	+0·01
6	0·08	0·27	-0·19	15	0·29	0·16	+0·13
7	0·11	0·27	-0·16	16	0·26	0·22	+0·04
8	0·20	0·19	+0·01	17	0·32	0·28	+0·04
9	0·24	0·17	+0·07				

Mean Difference = 0·000 ft.

DUNMORE.—TABLE C.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDES *at Dunmore at Low Water; Positive Heights for Seventeen Lunations, commencing* 1850, *September* 13^d 17^h, *and ending* 1851, *December* 22^d 22^h 30^m.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·11	0·13	-0·02	10	0·06	0·07	-0·01
2	0·15	0·14	+0·01	11	0·08	0·09	-0·01
3	0·05	0·06	-0·01	12	0·13	0·13	0·00
4	0·28	0·07	+0·21	13	0·18	0·19	-0·01
5	0·18	0·14	+0·04	14	0·18	0·15	+0·03
6	0·17	0·16	+0·01	15	0·14	0·11	+0·03
7	0·20	0·21	-0·01	16	0·13	0·11	+0·02
8	0·08	0·15	-0·07	17	0·14	0·14	0·00
9	0·10	0·11	-0·01				

Mean Difference = + 0·001 ft.

DUNMORE.—TABLE D.

COMPARISON OF THE OBSERVED AND CALCULATED DIURNAL TIDES *at Dunmore at Low Water; Negative Heights for Seventeen Lunations, commencing* 1850, *September* 13^d 17^h, *and ending* 1851, *December* 22^d 22^h 30^m.

No.	Observed.	Calculated.	Difference.	No.	Observed.	Calculated.	Difference.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.
1	0·23	0·22	+0·01	10	0·15	0·12	+0·03
2	0·18	0·14	+0·04	11	0·09	0·11	-0·02
3	0·23	0·13	+0·10	12	0·20	0·12	+0·08
4	0·23	0·12	+0·11	13	0·10	0·18	-0·08
5	0·13	0·12	+0·01	14	0·14	0·22	-0·08
6	0·18	0·19	-0·01	15	0·15	0·16	-0·01
7	0·18	0·20	-0·02	16	0·15	0·13	+0·02
8	0·18	0·20	-0·02	17	0·20	0·13	+0·07
9	0·11	0·13	-0·02				

Mean Difference = + 0·006 ft.

Dunmore.—Table E.

Difference *of Observed and Calculated Times of Vanishing of Diurnal Tide at Dunmore, at High Water, expressed in Lunar Days.*

Age of Lunar Tide = $5^d\ 19^h$.

No.	Difference.	No.	Difference.	No.	Difference.	No.	Difference.
	Days.		Days.		Days.		Days.
1	-2·65	10	+1·10	19	+0·10	28	-0·40
2	-1·56	11	+4·10	20	-1·90	29	-0·90
3	+1·60	12	+1·60	21	-1·90	30	+0·80
4	+0·30	13	-2·40	22	+0·50	31	0·00
5	-0·90	14	-0·90	23	-1·15	32	+2·60
6	+1·85	15	+0·10	24	+1·35	33	-0·20
7	+0·60	16	-1·56	25	-1·15	34	+2·10
8	+1·60	17	-0·90	26	+1·35	35	-0·50
9	+1·10	18	-2·90	27	-0·90		

Mean Difference = 0·000 Days.

Dunmore.—Table F.

Difference *of Observed and Calculated Times of Vanishing of Diurnal Tide at Dunmore, at Low Water, expressed in Lunar Days.*

Age of Lunar Tide = $5^d\ 14^h$.

No.	Difference.	No.	Difference.	No.	Difference.	No.	Difference.
	Days.		Days.		Days.		Days.
1	-0·10	10	+1·40	19	+0·40	28	+1·40
2	-1·20	11	+1·40	20	-0·60	29	-0·60
3	-0·60	12	+2·80	21	-3·10	30	-3·10
4	-0·60	13	+0·20	22	-0·60	31	+0·20
5	-2·70	14	-0·60	23	+0·40	32	-1·00
6	-2·00	15	+1·70	24	+4·90	33	-0·60
7	-4·60	16	+1·90	25	+1·40	34	-0·10
8	-0·60	17	-0·60	26	+1·40	35	+3·40
9	+1·90	18	-2·60	27	+1·10		

Mean Difference = 0·000 Days.

The agreement between the Calculated and Observed Tides, shown in the preceding Tables, is excellent, and since the Tide itself is small, it proves the remarkable care with which the Observations were taken at this Station.

SECTION XIII.—GENERAL CONCLUSIONS RESPECTING THE DIURNAL TIDE.

Having discussed in detail the Solar and Lunar Diurnal Tides at each Station, it now remains to make a few comparisons of the results obtained. An interesting comparison of the Solar and Lunar Tide may be made at each Station, with respect to the relative influence of the Sun and Moon; with respect to the Tidal Intervals and Establishment; and with reference to the Age of the Tide.

1.—*Relative Effects of the Sun and Moon.*

Arranging our Stations in two groups,—Atlantic and Channel Stations,—we form the following Table from the Constants previously given:—

Relative Effects of the Sun and Moon.

	Solar Coefficient.	Lunar Coefficient.	$\frac{S}{M}$
Atlantic Stations.	Feet.	Feet.	
Caherciveen, . .	0·335	0·480	0·698
Bunown, . . .	0·342	0·646	0·529
Rathmullan, . .	0·315	0·632	0·498
Channel Stations.			
Portrush, . . .	0·342	0·519	0·659
Cushendall, . . .	0·376	0·881	0·427
Donaghadee, . .	0·383	0·868	0·441
Kingstown, . . .	0·348	0·690	0·504
Courtown, . . .	0·410	0·719	0·570
Dunmore East, .	0·192	0·441	0·436
Mean, ...			0·5305

The mean ratio of S to M, here found, shows that the Sun's effect on the Diurnal Tide is somewhat more than half the Moon's effect. In Mr. Airy's discussion of the Semidiurnal Tides of Ireland, the following mean ratios of S to M are found :[*]—

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[*] Transactions of Royal Society for 1845.

Page 35, ...	0·33	deduced from	Heights.
Page 106, ...	0·34	do.	do.
Page 42, ...	0·35	deduced from	Times.
Page 108, ...	0·38	do.	do.
Mean, . .	0·35		

According to the Statical Theory of the Tides, the ratio of the Solar to the Lunar effect should be the same for the Diurnal and for the Semidiurnal Tides; but according to the Dynamical Theories of the Tides, the coefficients in the Solar and Lunar Tides depend in a different manner on the depth of the sea, and therefore, the ratios deduced from the Diurnal and Semidiurnal Tides should be different. According to the Statical Theory of the Tides, excluding the terms depending on Parallax, Declination, Hour of Tide, &c., the ratio of the Solar to the Lunar Coefficient is as follows :—

$$\frac{\text{Solar Coefficient}}{\text{Lunar Coefficient}} = \frac{S}{M} \times \frac{d^3}{D^3}. \tag{6}$$

In this equation S and M denote the masses of the Sun and Moon, and D, d their mean distances from the Earth. Adopting the received values of these quantities, we should have

$$\frac{S}{M} = 359551 \times 85;$$

$$\frac{d}{D} = \frac{59{\cdot}964}{2 \times 12032},$$

and substituting these values in equation (6), we find,

$$\frac{\text{Solar Coefficient}}{\text{Lunar Coefficient}} = 0{\cdot}47288. \tag{7}$$

If, instead of calculating the right-hand side of (6), we consider $\frac{S}{M}$ as the unknown quantity, and introduce the values of the left-hand side deduced from the Tides, we obtain the two following values of the ratio of the Sun's mass to the Moon's, from the Semidiurnal and Diurnal Tides respectively,

$$\frac{S}{M}\text{(Semidiurnal Tide)} = 359551 \times 63,$$

$$\frac{S}{M}\text{(Diurnal Tide)} \qquad = 359551 \times 95.$$

It will be seen from the foregoing results, that the mass of the Moon as compared with that of the Earth, deduced from the Semidiurnal Tide, viz., $\frac{1}{63}$, is too great; while that deduced from the Diurnal Tide, $\frac{1}{95}$, is too small.

According to the Dynamical Theory of the Tides, the ratio of the Solar to the Lunar Coefficient, in the Semidiurnal Tide, is given by the equation,*

$$\frac{\text{Semidiurnal Solar Coefficient}}{\text{Semidiurnal Lunar Coefficient}} = \frac{S}{M} \times \frac{d^3}{D^3} \times \frac{\dfrac{n'^2b}{g} - \dfrac{k}{b}}{\dfrac{n^2b}{g} - \dfrac{k}{b}}. \tag{8}$$

In this equation, n, n' denote the angular velocities of the Sun and Moon; k, b the mean depth of the sea, and mean radius of the Earth; and g the force of gravity. Using the known values of these quantities, we find,

$$\frac{n^2b}{g} = 0{\cdot}00345,$$

$$\frac{n'^2b}{g} = 0{\cdot}00323,$$

$$\frac{S}{M} \times \frac{d^3}{D^3} = 0{\cdot}47288,$$

Substituting these values in (8), and taking the value of the left-hand member from Mr. Airy's Observations of Semidiurnal Tide, we find:—

$$0{\cdot}35 = 0{\cdot}47 \times \frac{0{\cdot}00323 - \dfrac{k}{b}}{0{\cdot}00345 - \dfrac{k}{b}}.$$

From which we obtain,

---

* Airy, "Tides and Waves," p. 357.

$$\frac{k}{b} = \frac{1}{386};$$

and, replacing b by its value $\frac{7912}{2}$, we find,

$$k = \text{depth of sea} = 10{\cdot}25 \text{ miles.}$$

This result differs considerably from that found by Mr. Airy, from other considerations respecting the Semidiurnal Tide, viz., 22 miles;* but it differs, in the opposite direction, from the depth deducible from the Diurnal Tides, by the aid of the Dynamical Theory. According to this theory, the ratio of the Solar to the Lunar Coefficient, is given by the following equation:—

$$\frac{\text{Diurnal Solar Coefficient}}{\text{Diurnal Lunar Coefficient}} = \frac{S}{M} \times \frac{d^3}{D^3} \times \frac{\frac{n'^2 b}{g} - 4\frac{k}{b}}{\frac{n^2 b}{g} - 4\frac{k}{b}}. \qquad (9)$$

Substituting, in this equation, the values already given, and assuming the left-hand member from the Diurnal Tide Observations, we obtain,

$$0{\cdot}53 = 0{\cdot}47 \, \frac{0{\cdot}00323 - 4\frac{k}{b}}{0{\cdot}00345 - 4\frac{k}{b}}.$$

from which we deduce,

$$\frac{k}{b} = \frac{1}{773},$$

and finally,

$$k = \text{depth of sea} = 5{\cdot}12 \text{ miles.}$$

It may be interesting to calculate from equation (9), what should be the ratio of the Solar to the Lunar Coefficient in the Diurnal Tide, from the Constants of the Semidiurnal Tide, deduced from Mr. Airy's observations.

Substituting, in this equation, for $\frac{k}{b}$, its value from the Semidiurnal Observations, $\frac{1}{386}$, we find,

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* "Philosophical Transactions" for 1845, p. 105.

$$\frac{\text{Diurnal Solar Coefficient}}{\text{Diurnal Lunar Coefficient}} = 0{\cdot}47 \times \frac{713}{691} = 0{\cdot}485,$$

a result, which although sensibly different from the value deduced from observation, viz. 0·5305, yet is not inconsistent with it; and inasmuch as it is greater than 0·35, the Semidiurnal Coefficient, it lies in the right direction, and is so far a confirmation of Theory.

If, on the other hand, we calculate the Semidiurnal ratio of Coefficients from equation (8), by substituting in it for $\frac{k}{b}$, its value $\frac{1}{773}$, deduced from the Diurnal Observations, we find,

$$\frac{\text{Semidiurnal Solar Coefficient}}{\text{Semidiurnal Lunar Coefficient}} = 0{\cdot}47 \times \frac{194}{216} = 0{\cdot}422;$$

a result which differs considerably from the mean value, 0·35, deduced from Mr. Airy's Observations.

If we compare the results just obtained from the Diurnal Tide Observations, with the results deduced by Laplace from Semidiurnal Tides observed at Brest, we shall find that there is a very striking agreement. In the *Mecanique Celeste*, tom. v. p. 206 (*Paris*, 1825), the ratio of the Semidiurnal Lunar Coefficient to the Solar Coefficient, deduced from observation, is stated to be 2·35333, from which Laplace infers the Moon's mass to be $\frac{1}{74{\cdot}9}$; from this result we find,

$$\frac{\text{Semidiurnal Solar Coefficient}}{\text{Semidiurnal Lunar Coefficient}} = \frac{1}{2{\cdot}35333} = 0{\cdot}42494,$$

a result almost identical with that just deduced from our Diurnal Constants, viz., 0·422.

If we substitute Laplace's ratio in equation (8), we find,

$$\frac{425}{473} = \frac{323 - 100000\,\frac{k}{b}}{345 - 100000\,\frac{k}{b}},$$

from which we deduce

$$\frac{k}{b} = \frac{1}{780}, \text{ and } k = 5{\cdot}07 \text{ miles.}$$

The mean depth of the sea here found agrees with that inferred from the Diurnal Observations, and is only half that deduced, by me, from Mr. Airy's Semidiurnal Observations, which, however, accord better with the mean depth deducible from the Lunitidal and Solitidal Diurnal Intervals, and from the Age of the Lunar Diurnal Tide, as will be shown presently.

2.—*The Lunitidal and Solitidal Intervals.*

If we place the Lunitidal and Solitidal Intervals in a Table, arranged in the order of the Atlantic and Channel Stations, we obtain the following results:—

Diurnal Tidal Intervals and Establishments.

	Lunitidal Interval.	Solitidal Interval.	Establishment of Lunar Tide.	Establishment of Solar Tide.
Atlantic Stations.				
Caherciveen, . .	0h 6m	3h 28m	0h 46m	4h 8m
Bunown, . . .	0 31	2 52	1 11	3 32
Channel Stations.				
Rathmullan, . .	4 6	9 40	4 36	10 10
Portrush, . . .	3 43	11 30	4 9	11 56
Cushendall, . . .	7 16	11 25	7 40	11 49
Donaghadee, . .	7 49	11 12	8 11	11 34
Kingstown, . . .	7 39	10 26	8 3	10 50
Courtown, . . .	5 28	5 1	5 53	5 26
Dunmore East, .	1 48	5 15	2 16	5 43

The last two columns of this Table express the Interval from the Lunar or Solar passage of the Greenwich Meridian to High Water, at each Station; they are formed by adding the longitude, in time, of each Station to the Tidal Intervals.

It is possible, from Mr. Airy's Theory of Tides with Friction, to deduce the mean depth of the sea from the preceding Table of Tidal Intervals, and the results of this calculation, although different from the depth deduced from the Heights, are consistent with each other, and well worthy of attention.

According to the Theory of Tide Waves without friction, Low Water should occur at the time of meridian passage of the luminary; in consequence of friction, the phase of High Water is accelerated by an interval equal to the difference between the Tidal Interval and the period of half a Tide Oscillation. Subtracting, therefore, the Lunitidal and Solitidal Intervals from $12^h\ 24^m$, and 12^h, respectively, we find the accelerations. In this manner, the first two columns of the following Table are constructed, and the depths calculated by a method which will be explained:—

Accelerations of High Water of Lunar and Solar Diurnal Tide.

	Lunitidal Acceleration.	Solitidal Acceleration.	Ratio.	Depth of Sea.
				Miles.
Caherciveen, . .	$12^h\ 18^m$	$8^h\ 32^m$	1·44	10·94
Bunown, ...	11 53	9 8	1·30	10·01
Rathmullan, . .	8 18	2 20	3·56	12·59
Portrush, . . .	8 41	0 30	17·37	12·88
Cushendall, . . .	5 8	0 35	8·80	12·82
Donaghadee, . .	4 35	0 48	5·73	12·75
Kingstown, . . .	4 45	1 34	3·03	12·50
Dunmore, . . .	10 36	6 45	1·57	11·40
Mean, ...				11·986

According to the Theory of Tides, including Friction,[*] the acceleration of High Water is represented by

$$\frac{f}{i^2 - gkm^2}$$

where

$f =$ coefficient of friction,
$i =$ angular velocity of luminary,
$g = 32$ ft.
$k =$ depth of the sea,
$m = \frac{2\pi}{\lambda}$,
$\lambda =$ length of tide wave.

Hence, comparing the Lunitidal and Solitidal accelerations, we find,

$$\frac{\text{Lunitidal Acceleration}}{\text{Solitidal Acceleration}} = \frac{i'^2 - gkm^2}{i^2 - gkm^2}; \tag{10}$$

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[*] *Vide* Airy's "Tides and Waves," p. 332.

and, substituting the following values,

$$i' = \frac{2\pi}{86400}, \quad i = \frac{2\pi}{89280},$$
$$m = \frac{2\pi}{25000 \times 5280},$$

we find, expressing the depth in miles,

$$\frac{\text{Acceleration of Lunar Tide}}{\text{Acceleration of Solar Tide}} = \frac{13{\cdot}815 - k}{12{\cdot}938 - k} \qquad (11)$$

It is by the aid of this equation that the depths of the sea given in the Table are calculated. These depths agree remarkably well together, and although they differ considerably from the depths found from the Heights of the Lunar and Solar Tides, we shall find them confirmed in a remarkable manner by the depths of the sea, deducible from the Age of the Lunar Diurnal Tide.

The progress of the Lunar and Solar Diurnal Tide Wave round the island is seen from the column of Establishments, from which it appears that the Diurnal Tide Wave approaches Ireland from the west, and, flowing round the island north and south, enters the Irish Sea at both extremities; the two waves meeting off the coast of Down, in the case of the Lunar Tide; and further north, off the Antrim coast, in the case of the Solar Tide.

The direction of the Lunar Tide Wave before it enters the Channel may be thus ascertained; let

The distance from Caherciveen to Bunown . . . . . . = a,
" " Dunmore . . . . . . = b,
" " Portrush . . . . . . = c,
The difference of Establishments at Caherciveen and Bunown = α,
" " Caherciveen and Dunmore = β,
" " Caherciveen and Portrush = γ,
The angle between direction of Tide and Bunown . . . = A,
" " Dunmore . . . = B,
" " Portrush . . . = C,

It is easy to see that we have the following equations,

$$\frac{a\cos A}{b\cos B}=\frac{\alpha}{\beta}, \qquad \frac{a\cos A}{c\cos C}=\frac{\alpha}{\gamma}; \tag{12}$$

and, since the angle between Bunown and Dunmore is 84°, and between Bunown and Portrush is 32°, we have also,

$$A+B=84^\circ, \qquad A-C=32^\circ. \tag{13}$$

The following values of a, b, c, are found by measurement; and of α, β, γ, from the Table of Establishments,

$$a=444, \quad \alpha=25^{\mathrm{m}},$$
$$b=590, \quad \beta=90^{\mathrm{m}},$$
$$c=1207, \quad \gamma=203^{\mathrm{m}}.$$

Introducing these values into equations (12) and (13), we obtain from the first equation,

$$A=69^\circ\ 6';$$

and from the second equation,

$$A=76^\circ\ 6'.$$

The mean of these two values is 72° 36′, and since the line joining Caherciveen and Bunown is a meridian (nearly), it follows that the Lunar Diurnal Cotidal line, on the west coast of Ireland, is 17° 24′ west of north; and that the Tide approaches the coast from the W. 17° 24′ S.

The Solar Diurnal Tide approaches the coast in a different direction, as is seen from the fact that it arrives at Bunown before it reaches Caherciveen; and it also appears to undergo some unexplained retardation in the narrow channel between Antrim and Scotland, as it arrives at Cushendall and Portrush later than at any other stations.

3.—*Age of Lunar Diurnal Tide.*

The following Table gives the Age of the Lunar Diurnal Tide at each of the Irish stations:—

Age of Lunar Diurnal Tide.

	High Water.	Low Water.
Caherciveen,	$5^d\ 4^h$	$4^d\ 17^h$
Bunown,	4 9	4 9
Rathmullan,	5 10	4 20
Portrush,	5 9	4 19
Cushendall,	6 19	5 3
Donaghadee,	6 5	5 2
Kingstown,	6 17	4 11
Courtown,	6 22	3 12
Dunmore East,	5 19	5 14

A striking feature of this Table is the fact, that the Age of the Tide deduced from the observations made at High Water is greater than the Age deduced from the observations at Low Water, at all the stations, except Bunown, at which the Ages deduced are equal.

I am unable to explain this fact, but it clearly indicates a defect in the Theory of the Tides, which would show the same Age to correspond with either High or Low Water.

Some very interesting inferences respecting the mean depth of the sea follow, from comparing the Age of the Lunar Diurnal Tide with the Acceleration of the Lunar Tide, given in the Table at p. 134. The following Table contains the results of this comparison:—

Mean Depth of Sea deduced from the Age of Lunar Diurnal Tide.

	Age.	Acceleration.	Ratio.	Depth of Sea.
	Hours.	Hours.		Miles.
Caherciveen,	118·5	12·30	9·63	10·50
Bunown,	105·0	11·88	8·84	10·31
Rathmullan,	123·0	8·30	14·82	11·30
Portrush,	122·0	8·68	14·05	11·22
Cushendall,	143·0	5·13	27·87	12·04
Donaghadee,	135·5	4·58	29·58	12·09
Kingstown,	134·0	4·75	28·21	12·05
Dunmore East,	136·5	10·60	12·88	11·07
Mean,				11·322

In this Table, the second column contains the *mean* Age of the Tide; the third column the Acceleration of the Tide, both expressed in hours; the fourth column contains the ratio of the Age to the Acceleration; and the last column exhibits the mean depth of the sea, deduced in a manner which will be explained.

The mean sea depths of the preceding Table are deduced, as follows, from Mr. Airy's Theory of Tide Waves with Friction. It is proved ("Tides and Waves," p. 333), that

$$\frac{\text{Age of Lunidiurnal Tide}}{\text{Acceleration of Lunidiurnal Tide}} = \frac{i^2 + gkm^2}{i^2 - gkm^2}, \tag{14}$$

which becomes, introducing the values already given, and expressing k in miles,

$$\frac{\text{Age of Lunidiurnal Tide}}{\text{Acceleration of Lunidiurnal Tide}} = \frac{12{\cdot}938 + k}{12{\cdot}938 - k}. \tag{15}$$

The sea depths are calculated from the preceding equation, and their mean value 11·32 miles, is a striking confirmation of the mean depth derived from the comparison of the Lunitidal and Solitidal Intervals; and at the same time a confirmation of Mr. Airy's Theory of Tide Waves with Friction. In fact, the existence of a Tidal Age or Acceleration is altogether due to friction, and, therefore, the similarity of the two independent results must be regarded as proving that the values of the Lunitidal Age, and Solitidal and Lunitidal Intervals deduced from observation, agree with each other in the manner indicated by Theory.

It may be asked, how are we to reconcile this value of the mean sea depth with that deduced from Diurnal Heights, and from Laplace's results of the Semidiurnal Tides at Brest. Although this question is difficult to answer fully, yet it should be observed that the results deduced from Intervals and Ages are more consistent with each other than those deduced from Heights, and also that they are confirmed by the sea depth deducible from Mr. Airy's Irish Observations. And it may be also suggested, that probably the depth inferred from Age and Acceleration is the depth of the sea at a greater distance from the coast, while the depth deduced from Heights is the depth of the sea after it has began to shoal, the tide being composed partly of a derivative and partly of the original Atlantic Tide.

Is it impossible, or improbable, that the result inferred from Age and Acceleration, viz., 11·65 miles, is the depth of the South Atlantic and Antarctic Oceans, while the depth deduced from Heights, viz., 5·12 miles, is the mean depth of the eastern portion of the North Atlantic ?

I shall leave this and other interesting questions to those concerned in the Mathematical Theory of the Tides, and shall feel content to have contributed, as my share, a few facts to serve as a partial basis for reconstructing the Theory of the Tides, which must be considered at present as a reproach to Mathematical Science. The separation of the Solar and Lunar Diurnal Tides on the coasts of Ireland, and the partial investigation of their laws, must be regarded as an important accession to our knowledge of the Tides—an accession which must be considered as arising, in a great degree, from the exertions of the Royal Irish Academy.